JetMove 105

Drive

JetWeb

User Manual

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Revision 2.10.1

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This Operator's Manual is an Integral Part of the JetMove 105:

Type:	_____
Serial #:	_____
Year of construction:	_____
Order #:	_____

CE

To be entered by the customer:

Inventory #:	_____
Place of operation:	_____

Significance of this User Manual

This user manual is an integral part of the digital servo amplifier JetMove 105 and

- must be kept in a way that it is always at hand until the the digital servo amplifier JetMove 105 will be disposed of.
- Pass this manual on if the digital servo amplifier JetMove 105 is sold or loaned/ leased out.

In any case you encounter difficulties to clearly understand this user manual, please contact the manufacturer.
We would appreciate any suggestions and contributions on your part and would ask you to contact us. This will help us to produce manuals that are more user-friendly and to address your wishes and requirements.

This manual contains important information on how to transport, erect, install, operate, maintain and repair the digital servo amplifier JetMove 105.
Therefore, the persons carrying out these jobs must carefully read, understand and observe this manual, and especially the safety instructions.

Missing or inadequate knowledge of the manual results in the loss of any claim of liability on part of Jetter AG. Therefore, the operating company is recommended to have the instruction of the persons concerned confirmed in writing.

System Requirements

This user manual is giving a description of the motion system JetMove 105 with operating system version 2.10.0.0

History

Auflage	Comment
2.09.1	Original issue
2.10.1	DC and stepper motor have been integrated

Description of Symbols

Warning

This sign is to indicate a possible impending danger of serious physical damage or death.

Caution

This sign is to indicate a possible impending danger of light physical damage.
This sign is also to warn you of material damage.

This sign indicates hazard of life due to electric shock caused by a high operating voltage.

This sign is to indicate hazard of serious physical damage or death due to accidentally touching dangerous parts of the device.

Important

This sign is to indicate a possible impending situation which might bring damage to the product or to its surroundings.
It also identifies requirements necessary to ensure faultless operation.

Note

You will be informed of various possible applications and will receive further useful suggestions.
It also gives you words of advice on how to efficiently use hardware and software in order to avoid unnecessary efforts.

· / -

Enumerations are marked by full stops, strokes or scores.

Operating instructions are marked by this arrow.

Automatically running processes or results to be achieved are marked by this arrow.

PC and user interface keys.

This symbol informs you of additional references (data sheets, literature, etc.) associated with the given subject, product, etc. It also helps you to find your way around this manual.

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1 Safety Instructions

1.1 Generally Valid Safety Instructions

The digital servo amplifier JetMove 105 fulfils the accepted safety regulations and standards. Special emphasis was given to the safety of the users.

Of course, the user should adhere to the following regulations:
- pertinent accident prevention regulations;
- accepted safety rules;
- EC guidelines and other country-specific regulations.

1.1.1 Usage to the intended purpose

Usage to the intended purpose includes operation in accordance with these operating instructions.

The digital servo amplifier JetMove 105 may only be operated in the closed control cabinet and within the range of the set values, see chapter 5 "Technical Data", page 35.
Do not apply a voltage to the digital servo amplifier JetMove 105 that is higher than the prescribed operating voltage.
The operating voltage for the motor power supply of the digital servo amplifier JetMove 105 ranges between 12 V und 48 V DC. Thus, the digital servo amplifier does not come under the EC Low Voltage Directive.

The servo amplifier JetMove 105 is for driving electric motors of various designs. The winding isolation of the motors must be higher than, or at least equal to, the DC link voltage supplied by the servo amplifier.

The digital servo amplifier JetMove 105 is used to control machinery, such as conveyors, production machines, and handling machines.

1.1.2 Non-intended use

The digital servo amplifier must not be used in technical systems which to a high degree have to be fail-safe, e.g. ropeways and aeroplanes.

Please do not use the integrated braking circuit in applications, where, in case of braking circuit failure, safety hazards can occur.

If the digital servo amplifier JetMove 105 is to be run under operating conditions, which differ from the conditions mentioned in chapter 3 "Operating Conditions", page 27, the manufacturer must be contacted beforehand.

1.1.3 Who is permitted to operate the servo amplifier JetMove 105?

Only instructed, trained and authorised persons are permitted to operate the servo amplifier JetMove 105.

Transport:	Only by personnel with knowledge in handling electrostatically sensitive components.
Installation:	Only by specialists with training in electrical engineering.
Commissioning:	Only by specialists with extensive knowledge of, and experience with, electrical engineering / drive technology.

1.1.4 Modifications and alterations to the module

Due to safety reasons, neither opening the digital servo amplifier JetMove 105, nor carrying out any modifications or alterations to the device and its functions is allowed.
Any modifications to the servo amplifier JetMove 105 not expressly authorised by the manufacturer will result in a loss of any liability claims to Jetter AG.

The original parts are specifically designed for the servo amplifier JetMove 105. Parts and equipment of other manufacturers are not tested on our part, and are, therefore, not released by us.
The installation of such parts may impair the safety and the proper functioning of the digital servo amplifier JetMove 105.

Any liability on the part of Jetter AG for any damages resulting from the use of non original parts and equipment is excluded.

1.1.5 Repairs and servicing of the JetMove 105

Repairs at the digital servo amplifier JetMove 105 must not be carried out by the operator. The servo amplifier JetMove 105 does not contain any parts to be repaired by the operator.
For being repaired, the servo amplifier JetMove 105 must be sent to Jetter AG.

The digital servo amplifier JetMove 105 is maintenance-free. Therefore, absolutely no inspection or maintenance works are required for the operation of the module.

1.1.6 Decommissioning and disposing of the JetMove 105

In case of obvious damage or erratic behaviour, the servo amplifier must not be used any more.

The environmental regulations for the respective country apply to decommissioning and disposing of the digital servo amplifier on the operating company's premises.

You can disassemble the digital servo amplifier JetMove 105 into its main components by unscrewing it (aluminium heat sink and side plate, steel casing cover, electronic boards).

1.2 Ensure Your Own Safety

Warning

- Isolate the digital servo amplifier JetMove 105 from the mains, if maintenance works have to be carried out. By doing so, you will prevent accidents resulting from electric voltage and moving parts.
  Please follow the information given in chapter 1.3 "Residual Dangers", page 14.
- Safety and protective devices, e.g. the cover of the terminal box must not in any case be shunted or by-passed.
- Dismantled protective equipment, such as the fuses must be reattached prior to commissioning and checked for proper functioning.
- Before commissioning, the machine manufacturer must carry out a hazard analysis of the respective machine and take adequate measures so that inadvertent motions will not lead to personal injury and to material damage.

1.2.1 Malfunctions

- **In the case of malfunctions or other faults, please immediately separate the digital servo amplifier JetMove 105 from the mains.**
  Please follow the information given in chapter 1.3 "Residual Dangers", page 14.
- Malfunctions or other damages are to be reported to an authorised person at once.
- Secure the digital servo amplifier JetMove 105 against misuse or accidental use.

1.2.2 Information signs and labels

- Writings, information signs, and labels always have to be observed and kept readable.
- Damaged or unreadable information signs and labels have to be exchanged.

1.2.3 Earthing procedure

- Screw the enclosure of the digital servo amplifier JetMove 105 onto a highly conducting, plane and earthed panel.
- Connect earth (X1:PE) with an earthing position of good quality. Use a short line of a great cross-section.

1.3 Residual Dangers

1.3.1 Hazards during operation

DANGER of hot surfaces!

Caution

During operation, the surfaces, respectively the heat sinks of the servo amplifier JetMove 105 can heat up. The left sidewall and the rear can reach temperatures of up to 85 °C.

- **Please do by no means touch the left sidewall or the rear of the servo amplifier JetMove 105 during operation and after switching off, while the device is still cooling down.**
- Please make sure that no temperature-sensitive parts have been connected or fastened to the servo amplifier JetMove 105.

DANGER in potentially explosive atmosphere!

Warning

Do not operate the digital servo amplifier JetMove 105 in a potentially explosive atmosphere.

DANGER of injuries caused by mechanic force!

Caution

The digital servo amplifier JetMove 105 drives a motor. This motor moves mechanic parts or sharp edges. Therefore, failure or malfunctioning of the digital servo amplifier JetMove 105 can be dangerous for persons or damage the manufacturing plant to an amount depending on the respective kind of plant. This should be prevented by installing additional safety devices.

- One safety precaution is to install a second set of limit switches to interrupt the power supply of the motor.
- Another safety precaution would be installing a guard.

Make sure that hazards to persons are precluded even when the drive is rotating unintentionally.

Do not remove any guards.

Warning

Do not wear gloves, lest they should get caught in the rotating drive shaft.

Never touch a rotating drive shaft.

Do not touch the motor during or after operation:
There can be temperatures of up to 140 °C möglich.

1.4 Instructions on EMI

The digital servo amplifier JetMove 105 is intended for use in industrial surroundings. It may cause radio interferences when used in residential areas. It is operated at the operator's own risk.

The noise immunity of a system corresponds to the weakest component of the system. For this reason, correct wiring and shielding of cables is a precondition of noise immunity.

Important!

Measures for increasing immunity to interference:

- Earth the device adequately according to chapter 1.2.3 "Earthing procedure", page 14.
- Connect the motor cable. An optional PE rail must be close to the servo amplifier. Shield cables on both ends.
- If a motor power cable is used which includes cores for brake control, the brake control cores have to be separately shielded. The shielding braid must be placed on both ends of the applicable cables.
- Follow the instructions given in Application Note 016 "EMC-Compatible Installation of the Electric Cabinet" published by Jetter AG.

The following instructions are excerpts from Application Note 016:

- Screw the enclosure of the digital servo amplifier JetMove 105 onto a highly conducting, plane and earthed panel.
- On principle, **physical separation** should be maintained between signal and power lines. We recommend spacings greater than 20 cm. Cables and lines should cross each other at an angle of 90°.
- Shielded cables **must** be used for the following lines:
  Analog lines, data lines, motor cables coming from inverter drives (servo output stage, frequency converter), lines between components and interference suppressor filter, if the suppressor filter has not been placed at the component directly.
- Shield cables **at both ends**.
- Unshielded wire ends of shielded cables should be as short as possible.
- The entire shield **must**, in its entire perimeter, be drawn behind the isolation, and then be clamped under an earthed strain relief **with the greatest possible surface area**.

When male connectors are used:

- The shield (impedance shielding) **must**, in its entire perimeter, be drawn behind the shielding clamp of the metallised connector housing, respectively of the EMC gland bushing, its greatest possible surface area being clamped under the strain relief close to the JetMove 105.
- Only use metallized connectors, e.g. SUB-D with metallized housing. Make sure that the strain relief is directly connected with the housing here as well (see Fig. 1).

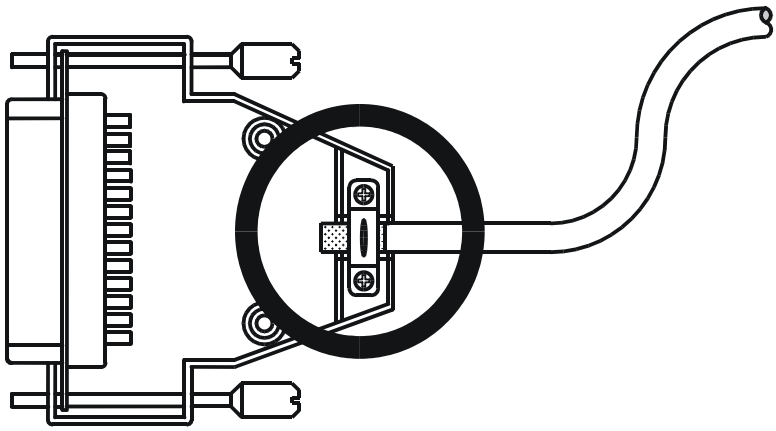


Fig. 1: Shielding of SUB-D connectors in conformity with EMC standards

If the shield cannot be attached to the connector, for example, with a screw type terminal:

It is important that shield and strain relief are highly conductive and directly connected to a grounded surface with the greatest possible surface area. Earthing must be done in a way that keeps the unshielded part of the signal lines as short as possible (see Fig. 2).

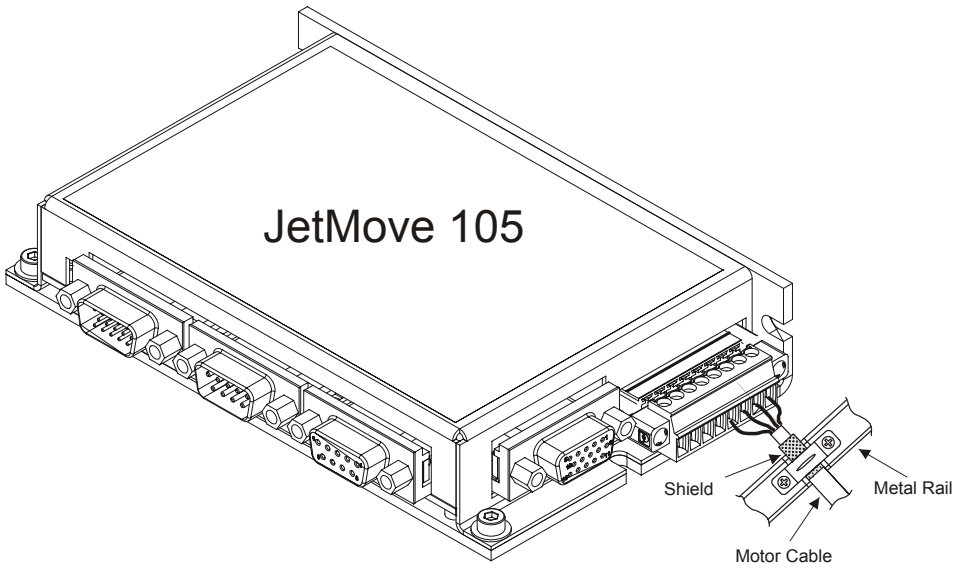


Fig. 2: Shielding of screw terminals in conformity with the EMC standards

2 Installation of the JetMove 105

2.1 Scope of Delivery

- Digital servo amplifier JetMove 105
- Plugged-on mating connector
- User manual

Accessories

The accessories are not included in the scope of delivery!

- System bus cable of cable confection # 530 x.x m; length: 0.2 m through 5.0 m. Please refer to chapter 7.10 "Jetter System Bus", page 79.
- Motor cable; please refer to chapter 7.3 "The Servo Motor", page 52 ff.
- Encoder cable; please refer to chapter 7.6 "Connection of the Resolver", page 68 ff.
- Motors, e.g. synchronous servo motors of the motor series JL1 or JH2, made by Jetter AG.
- DC voltage power supply
- Ballast resistor

Note!

If you are not sure which mounting accessories you require, please contact Jetter AG.

2.2 Mechanical Installation

- Prior to installing the digital servo amplifier check it for possible transport damages.
- Please check the shipment for completeness.
- To ensure proper functioning of the JetMove 105, check whether the mounting plate in the electric cabinet is unpainted.
- The JetMove 105 has been developed for natural convection. The mounting direction is horizontal (label on top) or vertical (motor line below). In both cases, a clearance of 25 mm between the JetMove 105 the surrounding devices or servo amplifiers has to be kept (see Fig. 4, page 22).
- Please make sure there is a clearance of at least 25 mm under and above the JetMove 105 - unobstructed ventilation must be granted.
- Please mark on the panel two positions for the fastening screw threads of the JetMove 105 (see Fig. 4, page 22).
- Drill the holes and the M4 threads into the panel.
- Screw the lower fitting bolt into the thread by approximately half of its length.
- By means of the oblong hole in the rear plate, hang up the JetMove 105 by the fitting bolts; then screw them tightly.
- Fix the upper fitting bolt in the oblong hole.

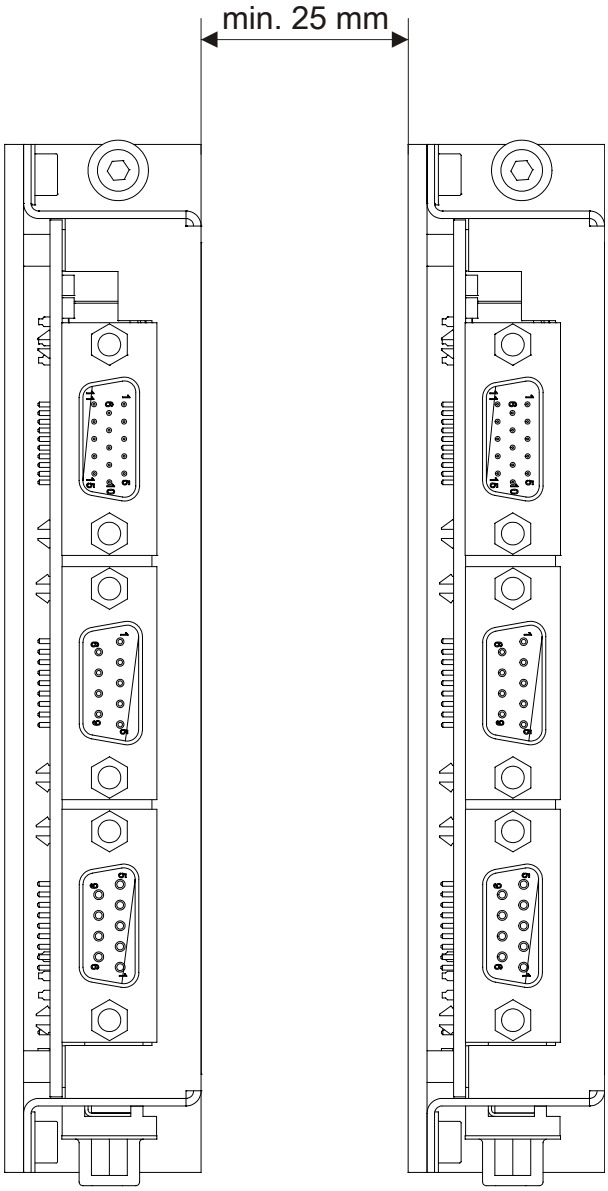


Fig. 3: Recommended mounting

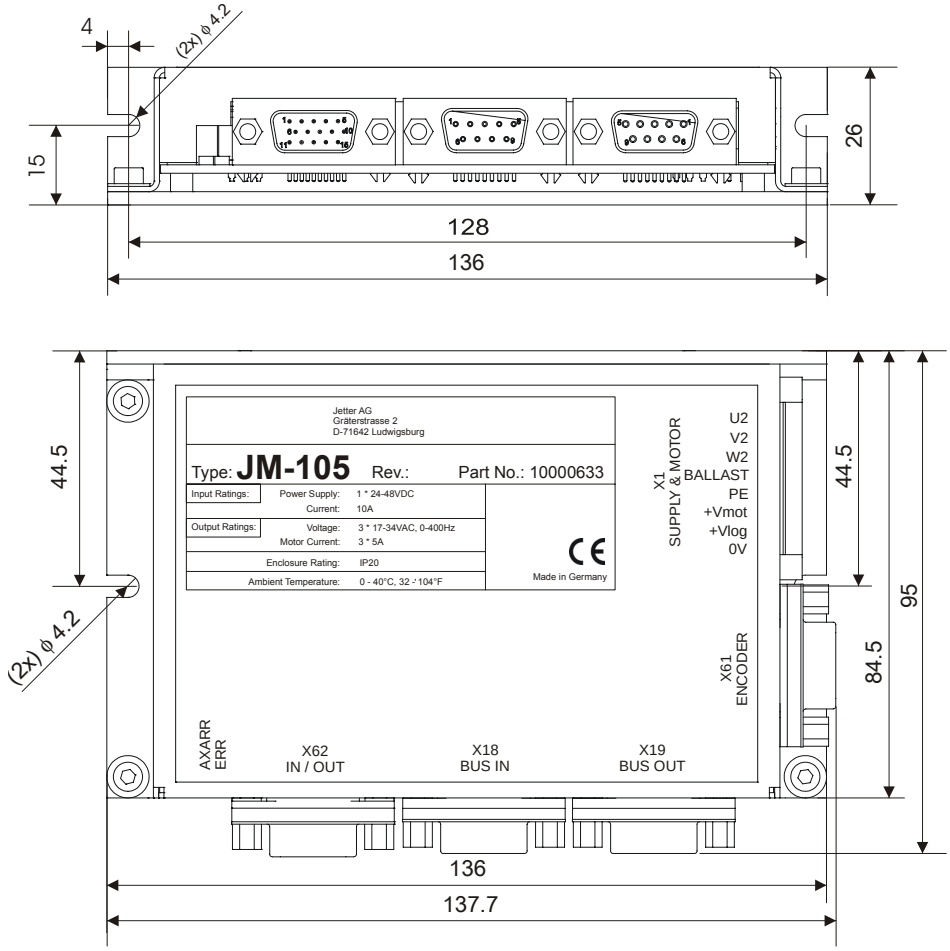


Fig. 4: Mounting holes in the enclosure

2.3 Electrical Installation

- Please check the assignments of servo amplifier and motor.
- Compare rated voltage and continuous rated current of servo amplifier and motor.
  The motor must be isolated against voltages of DC 100 V min.; please also refer to “Compatible Synchronous Servo Motors" on page 37.
- Connect the JetMove 105 according to the connection wiring diagram shown in chapter 10 "Wiring Diagrams", page 87.
  Especially check the power lines for appropriate protection, see page 88.
  Protecting the motor cables is not advisable.
- Select the cables according to standards.
- Please check, whether the ground cable has been connected.
- To connect resolvers or power units you can use prefabricated cables available from Jetter or opt for self-made cables. Please refer to chapter 7 "Description of Connections", page 43.
- To ensure that installation is carried out in conformance with EMC regulations, the following items have to be observed especially:
  – Please ground the 0 V phase as closely to the motor power supply unit as possible;
  – If possible, do not connect the controller cable together with the power supply and motor cable;
  – Connect the position transducer;
  – Use shielded terminals or EMC-compatible connectors;
  – Connect holding brake, if available, and connect shields on both sides of the cables;
  – Connect the motor leads according to Fig. 2, page 17.

  Please further note chapter 1.4 "Instructions on EMI", page 15.

2.4 Checking the Installation

- Check motor and servo amplifier wiring and connections by means of the connection diagrams used.
- Check the holding brake, if existing, for proper functioning.
- Check to see whether all necessary protection measures against accidental contact with live or moving parts have been taken.
- Carry out any other checks specific to or required for your system.

2.5 Notes on Safety as regards Commissioning

- Have commissioning jobs carried out by qualified personnel only, see chapter 1.1.3 "Who is permitted to operate the servo amplifier JetMove 105?", page 12.

What to do prior to commissioning

- Reattach dismantled protective equipment and check it for proper functioning.
  This way, protection from moving parts of the machine will be achieved.
- Secure the servo amplifier JetMove 105 against accidental contact with conductive parts and components.
- Only connect devices or electrical components to the signal lines of the digital servo amplifier JetMove 105 (Enable, Limit+/-, REF, BRAKE) that have been sufficiently isolated against the connected mains. These signal lines may only be connected with units that have got the ground potential of the $+V_{LOG}$ power supply.
- Accordingly, do only connect position transducers with the servo amplifier, if they have been sufficiently isolated from the connected mains.
- Always carry out each commissioning, even a short functional test, with correctly connected PE bus.

3 Operating Conditions

Operating Parameters Connected Load		
Parameters	**Value(s)**	**Standard Specification(s) Referred to**
Power Rating	Switching device at X1: +Vmot 24 / 48 V DC (12 .. 48 V DC) SELV or PELV $I_{max.}$ = 16.5 A Logic device at X1:+Vlog 24 V DC (12 .. 40 V DC) SELV or PELV $I_{max.}$= 250 mA at 24 V	
Supply Fluctuations	Voltage dips 3 ms max.	

Operating Parameters Environment		
Parameters	**Value(s)**	**Standard Specification(s) Referred to**
Operating Conditions	Temperature: 0 °C to +40 °C (+40 °C to +50 °C: Derating 2.5 %/K) Air humidity: 5 % to 85 %, non-condensing Make sure the control cabinet is being cooled sufficiently.	DIN EN 50178
Storage Conditions (Units Within Packing)	Temperature: -25 °C bis +55 °C, maximum fluctuation: 20 K/h Air humidity: 5 % to 95 %, non-condensing Maximum storage period: < 1 year without restrictions	DIN EN 50178
Transport Conditions (Units Within Packing)	Temperature: -25 °C to +70 °C Air humidity: 5 % to 95 %, non-condensing	DIN EN 50178
Pollution Degree	2	DIN EN 50178
Corrosion Immunity/Chemical Resistance	No special protection against corrosion. Ambient air must be free from higher concentrations of acids, alcaline solutions, corrosive agents, salts, metal vapours, or other corrosive or electroconductive contaminants	-

Operating Parameters Environment		
Atmospheric Pressure	Up to 1,000 m above sea level. From 1,000 m to 2,500 m above sea level with power reduction of 1.5 % per 100 m increase in height.	DIN EN 50178

Operating Parameters Mechanical Parameters		
Parameters	**Value(s)**	**Standard Specification(s) Referred to**
Free Falls Withstanding Test	Within original packing, the device withstands dropping over all of its edges	DIN EN 50178 DIN EN 60068-2-31
Vibration Resistance	• 10 Hz - 57 Hz: 0.075 mm amplitude • 57 Hz - 150 Hz: 1 g acceleration • 1 octave per minute, 10 frequency sweeps (sinusoidal), all three spatial axes	DIN EN 50178 DIN EN 60068-2-6
Degree of Protection	IP 20	DIN EN 60529
Mounting Position	Vertical and horizontal: Please make sure there is a clearance of at least 25 mm under and above the JetMove 206B-230 - sufficient ventilation must be granted.	

Important!

Measures to avoid damages in transit and storage:

The packaging material and the storage place are to be chosen in a way that the values given in the above table “Operating Parameters Mechanical Parameters" on page 28 are kept to.

Operating Parameters Electrical Safety		
Parameters	**Value(s)**	**Standard Specification(s) Referred to**
Protection Class	III	DIN EN 61800-5-1
Dielectric Strength	Protective network conductor and network logics: 380 V DC, 5 s	DIN EN 61800-5-1
Insulation	Protective network conductor and network logics: > 1 MΩ at 500 V	DIN EN 61800-5-1
Protective Connection	< 60 V, 25 A, 0.1 Ω	DIN EN 61800-5-1
Overvoltage Category	I	DIN EN 61800-5-1 DIN EN 50178 DIN VDE 0110-1 UL 508C

Operating Parameters EMI Immunity to Interference		
Parameters	**Value(s)**	**Standard Specification(s) Referred to**
Enclosure	• Frequency band 30 - 230 MHz, limit 50 dB (µV/m) in 10 m • Frequency band 230 - 1000 MHz, limit 60 dB (µV/m) in 10 m (second set of surroundings, setting category C3)	DIN EN 61800-3
Signal and control line connections, DC voltage supply inputs and outputs	Frequency bands: • 0.15 to 0.5 MHz, limit 100 dB (µV)* • 0.5 to 5 MHz, limit 86 dB (µV)* • 5 to 30 MHz, limit 90 dB (µV), decrease by the logarithm of the frequency up to 70 dB (µV)* * measured by a quasi peak detector (second set of surroundings, setting category C3)	DIN EN 61800-3

Important!

This is a product of restricted availability according to IEC/EN 61800-3. This module can cause radio interferences in residential areas. In this case, the user must take adequate measures to prevent this.

Operating Parameters EMI Immunity to Interference Enclosure		
Parameters	**Value(s)**	**Standard Specification(s) Referred to**
ESD	Discharge through air: Test peak voltage 8 kV Contact discharge: Test peak voltage 4 kV Acceptance criterion B (second set of surroundings, setting category C3)	DIN EN 61800-3 DIN EN 61000-4-2
RF Field amplitude-modulated	Frequency band 80 -1000 MHz; test field strength 10 V/m AM 80 % with 1 kHz Acceptance criterion A (second set of surroundings, setting category C3)	DIN EN 61800-3 DIN EN 61000-4-3

Operating Parameters EMI Immunity to Interference Power Connections		
Parameters	**Value(s)**	**Standard Specification(s) Referred to**
Burst (fast transients)	Test voltage 2 kV Repetition rate 5 kHz Acceptance criterion B (second set of surroundings, setting category C3)	DIN EN 61800-3 DIN EN 61000-4-4
Impulse Voltages	tr/th 1.2/50 µs, 8/20 µs 1 kV (Launching phase conductor against phase conductor) 2 kV (Launching phase conductor against ground potential) Acceptance criterion B (second set of surroundings, setting category C3)	DIN EN 61800-3 DIN EN 61000-4-5

Operating Parameters EMI Immunity to Interference Power Connections		
Guided radio disturbances	Frequency 0.15 - 80 MHz Test voltage 10 V AM 80 % with 1 kHz Acceptance criterion A (second set of surroundings, setting category C3)	DIN EN 61800-3 DIN EN 61000-4-6

Operating Parameters EMI Immunity to Interference Power Interfaces		
Parameters	**Value(s)**	**Standard Specification(s) Referred to**
Burst (fast transients)	Test voltage 2 kV Repetition rate 5 kHz Capacitive interference Acceptance criterion B (second set of surroundings, setting category C3)	DIN EN 61800-3 DIN EN 61000-4-4

Operating Parameters EMI Immunity to Interference Signal Interfaces		
Parameters	**Value(s)**	**Standard Specification(s) Referred to**
Burst (fast transients)	Test voltage 1 kV Repetition rate 5 kHz Capacitive interference Acceptance criterion B (second set of surroundings, setting category C3)	DIN EN 61800-3 DIN EN 61000-4-4
Guided radio disturbances	Frequency 0.15 - 80 MHz Test voltage 10 V AM 80 % with 1 kHz Acceptance criterion A (second set of surroundings, setting category C3)	DIN EN 61800-3 DIN EN 61000-4-6

Operating Parameters EMI Immunity to Interference Measuring and Control Circuits in Process Environments		
Parameters	**Value(s)**	**Standard Specification(s) Referred to**
Burst (fast transients)	Test voltage 2 kV Repetition rate 5 kHz Capacitive interference Acceptance criterion B (second set of surroundings, setting category C3)	DIN EN 61800-3 DIN EN 61000-4-4
Impulse Voltages	tr/th 1.2/50 µs, 8/20 µs 1 kV (Launching phase conductor against ground potential) Acceptance criterion B (second set of surroundings, setting category C3)	DIN EN 61800-3 DIN EN 61000-4-5
Guided radio disturbances	Frequency 0.15 - 80 MHz Test voltage 3 V AM 80 % with 1 kHz Acceptance criterion A (second set of surroundings, setting category C3)	DIN EN 61800-3 DIN EN 61000-4-6

4 Physical Dimensions

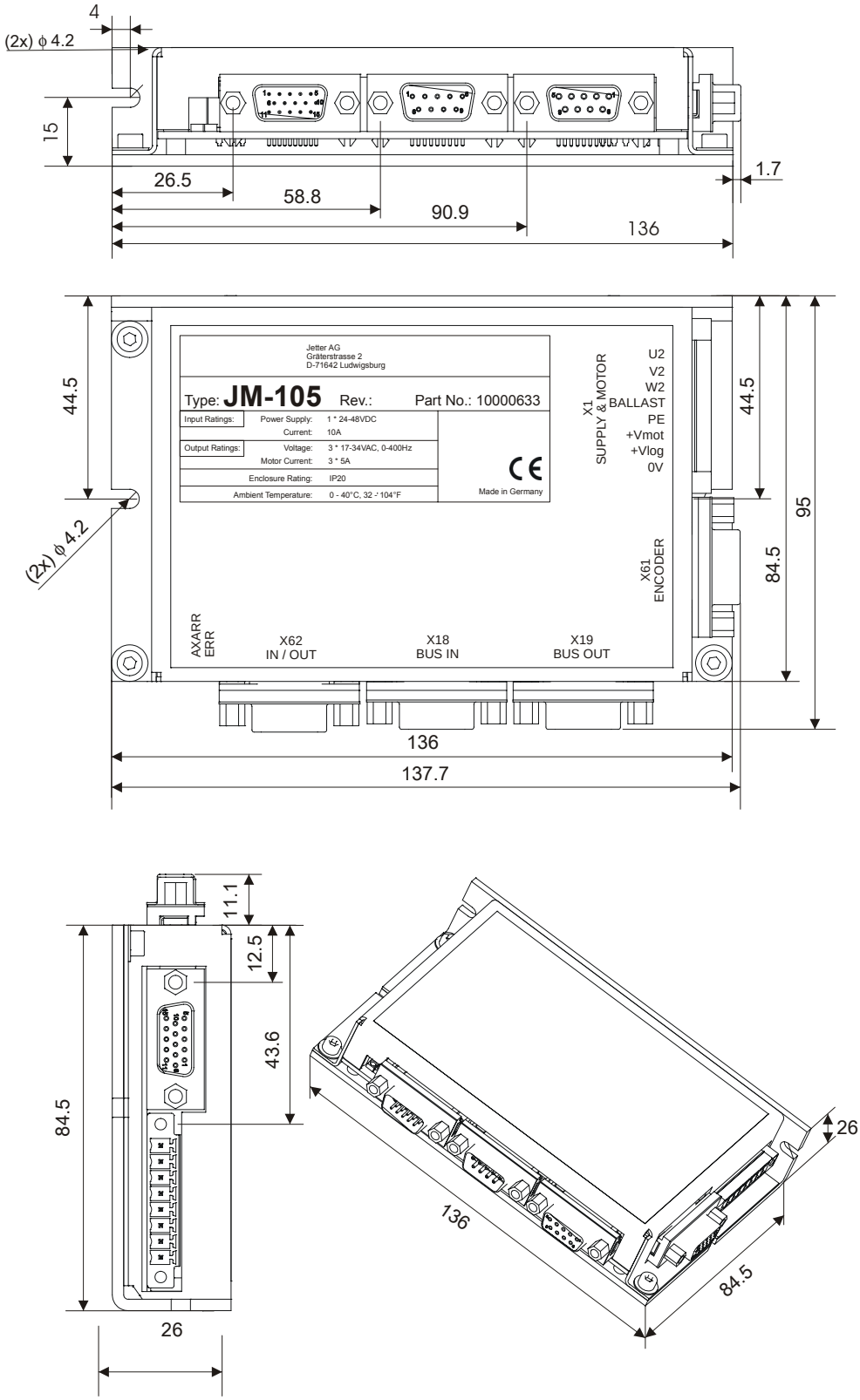


Fig. 5: Physical dimensions of the JetMove 105

For installation, please also refer to fig. 3 on page 21

5 Technical Data

5.1 Electrical Specification

Electrical Specification	
Motor voltage supply	• 24 / 48 V DC (12 .. 48 V DC) $I_{max.}$ = 16.5 A • The voltage output of the power supply unit must comply with the SELV or PELV type.
Inrush current limitation	The JM-105 is equipped with an internal 200 µF capacitor for buffering. The inrush current is not limited. See "Recommendations on the power supply On/Off switch +Vmot" on page 44.
Maximum output voltage of the motor	60 V
Motor output current at an ambient temperature of 40 °C	Nominal current: I_{eff} = 5 A Peak current: I_{eff} = 10 A (t <= 10 s at T < 40 °C)
Motor inductivity	125 µH min. between two motor lines
Rated output	240 W
Overcurrent protection, motor side	Designed for • phase to phase • phase to 0 V, respectively earth
Motor overload protection	See "Motor Protection" on page 38.
Cross-sectional area of motor power supply	1.0 mm² min.
Cross-sectional area of motor supply cable	0.75 mm² min., max. length = 50 m (for greater lengths, please contact Jetter AG)
Ballast resistor	An internal ballast resistor has not been installed. If the DC link voltage increases too much at decelerating the motor, an external ballast resistor has to be connected.
Residual voltage	The DC link voltage is discharged within 10 seconds at switching off the device.
Leakage current	< 0.1 mA at a cable length of 3 m The leakage current increases at increasing cable length. The zero-voltage connection is connected to earth by a resistor of 400 KΩ and a capacitor of 75 nF.

Electrical Specification	
Voltage supply of processor logics (demands on power supply module)	• 24 V DC (12 .. 40 V) 250 mA at 24 V additionally: 500 mA for the digital output additionally: 300 mA for encoder supply at X61 • The voltage output of the power supply unit must comply with the SELV or PELV type.
Inrush current limitation of the processor logics	The JM-105 is equipped with an internal 200 µF capacitor for buffering. The inrush current is not limited.
Enable1/2, Reference switch (REF), Positive limit switch (Limit+), Negative limit switch (Limit-), and input (Inp)	• DC 24 V (14 .. 32 V) related to the controller potential • 8 mA input current per input • Refer to chapter 7.9 "Digital and Analog Inputs and Outputs", page 77.
Braking circuit (X62:2)	Can be switched via controller program, or automatically at release of the motor current supply. 24 V DC ($+V_{log}$ - 0.5 V) $I_{max.}$ = 0.5 A Type of contact: Semiconductor switch (NOC, with integrated free-wheeling diode) The pin may only be connected to devices that are related to the same potential as the power supply of the controller logic.
Encoder supply (X61:1 and 6)	• Encoder supply voltage: 5 V DC +/-5 %, 350 mA max. • Encoder supply voltage: 24 V DC ($+Vl_{og}$ - 0.5V), 300 mA max.
Resolver inputs	• Resolver excitation: 8 Vpp • Frequency: 8 KHz • Input impedance: 30 KΩ
SinCos encoder inputs	• 1 Vpp differential signals • max. frequency: analog 450 KHz, digital 5 MHz • Input impedance: 30 KΩ
Incremental encoder inputs	• 5 V differential signals (RS422) or 5 V single-ended • max. frequency: 8 MHz, min. pulse: 50 ns • Input impedance: 15 KΩ
Analog input	• 1 differential channel • Resolution 12 Bit • Voltage range 0 .. 10 V • Value range 0 .. 32767 (in steps of 8) • Sampling interval 2ms • Input impedance 20 KΩ

Electrical Specification	
Power dissipation P_v	• Output stage at a rated output of 24 W typically, 36 W max. • Logic circuit: 6 W max.
Weight, mating connectors included	• JM-105: 500 g

Note 1!

Cooling:
- The overtemperature protection is activated at 85 °C.
- The overtemperature alarm is activated at 80 °C

Compatible Synchronous Servo Motors	
Motor types	Jetter motors of the JL1 and JH2 series

Note!

Should you intend to use motors other than the types mentioned above, please contact Jetter AG.

5.2 Motor Protection

5.2.1 I²t calculation

The digital servo amplifier JetMove 105 calculates the model of motor power loss by an I²t calculation. The determined value is related to the average power loss of the motor. It is specified in percent of the maximum power loss of the motor.
For this calculation it is important, that the parameters are entered correctly:
– Nominal current (which is the minimum of nominal motor current and nominal servo amplifier current),
– Overload factor
– and time constant of the motor

The I²t calculation must be activated by JetSym or by the PLC program.
It is possible to parameterize the warning level. The error level (error 30) is set to 100 %.

The I²t value is readable in a variable of JetMove 105 through JetSym or the PLC.

The digital servo amplifier JetMove 105 calculates the percentage of motor power loss according to the following formula:

$$x(t) = 100\% \times \left(\frac{\text{average motor current}}{\text{rated current}}\right)^2 \times \left(1 - e^{-\frac{t}{T}}\right)$$

x(t) =	displayed value of the motor power loss in %
t =	Time since start of motor running it with the average current (in seconds)
T =	Motor time constant (in seconds)

The formula shows that the 100 % value will never be reached as long as the average motor current is lower than the nominal current of the motor.
Further, calculating always starts by 0 (at t=0, the result of the equation is 0). After some time that is by far longer than the motor time constant, the result does virtually not change any more.
The time till error stop (x = 100 %) is a result of the following formula:

$$t = -T \times \ln\left[1 - \left(\frac{\text{rated current}}{\text{average motor current}}\right)^2\right]$$

After reset, the values of the important parameters are the following ones:

Nominal current:	5 A
Overload factor:	2
Motor time constant:	1,800 s (30 min)

With these parameters the 100 % error level will be reached if, for example the motor is run by a current of 10 A for about 8 minutes and 30 seconds.

Important

Because of the fact that after reset the I^2t calculation always starts with zero, the motor overload calculation is wrong if the motor has already warmed up when the digital servo amplifier JetMove 105 is switched on (i. e. at the time of parameters of I^2t calculation are written after switching on 24V logic power supply).
For this reason, please wait, until the motor has cooled down before re-enabling the axis.

6 Drive Controller Structure

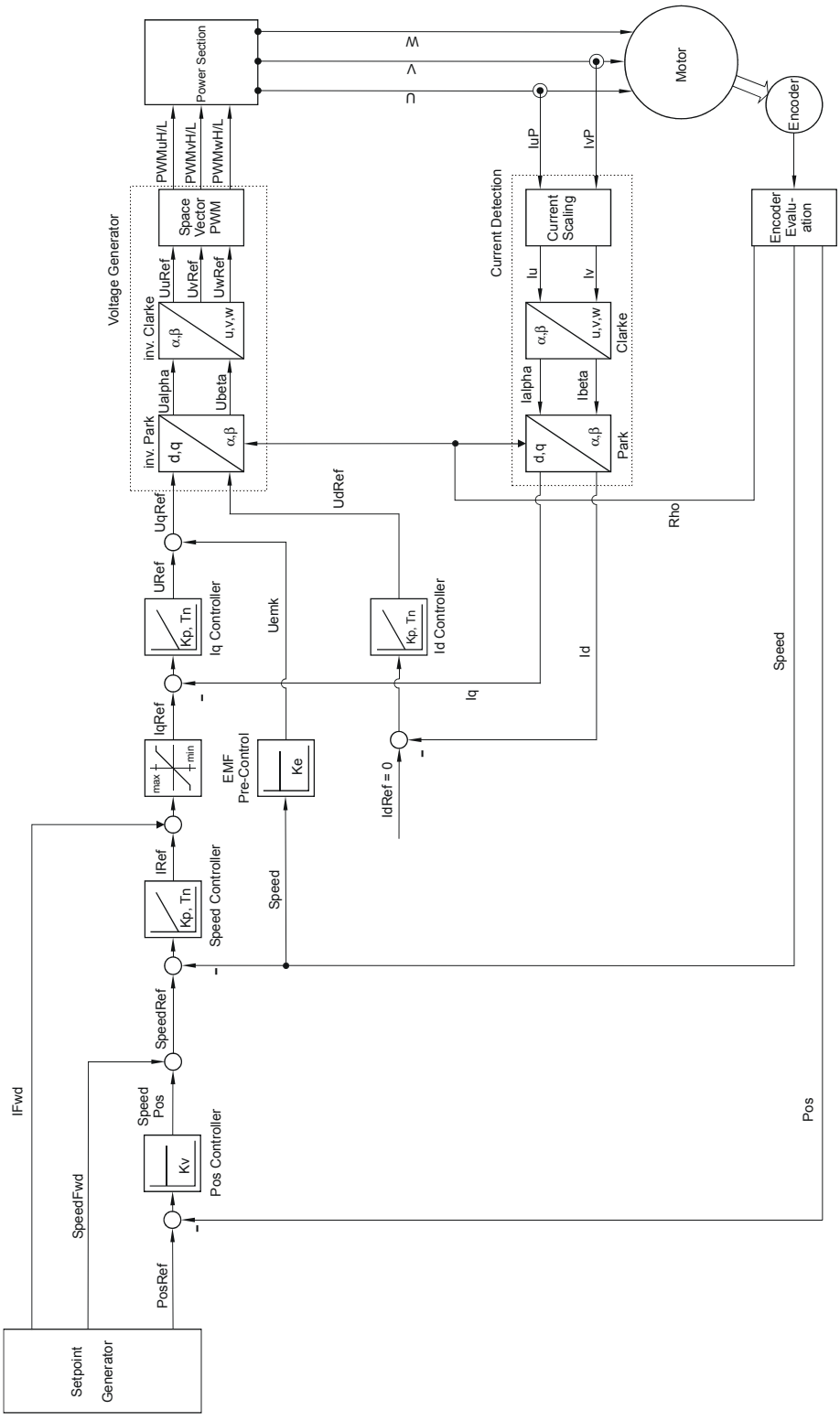


Fig. 6: Block diagram of drive controller structure

Drive Controller Specification

All drive controllers can be parameterized through the control program.

Function	Comment
Motor control (commutation)	Space vector modulation
PWM frequency	16 kHz
Current controller	
– Cycle time	62.5 µs
Speed controller	
– Cycle time	125 µs
– Power supply	adjustable
Position feedback controller	
– Cycle time	250 µs
– Speed pre-control	adjustable
Position setpoint generator	
– Sine-square and linear acceleration/deceleration ramp	can be parameterized individually
– Setpoint output cycle (position feedback controller interpolation)	2 ms
Position sensing	
Resolver:	
– Resolution	12 bits per revolution
– Scan time	62.5 µs
Sine-cosine-sensor:	
– Resolution of absolute position	15 Bit per encoder period
– Resolution of feedrate control	20 Bit per encoder period
– Scan time	62.5 µs

7 Description of Connections

7.1 Demands on the Power Supply Unit for Motor Operation Voltage

We recommend a power supply unit configuration consisting of transformer, rectifier and charging capacitor (electrolytic capacitor).

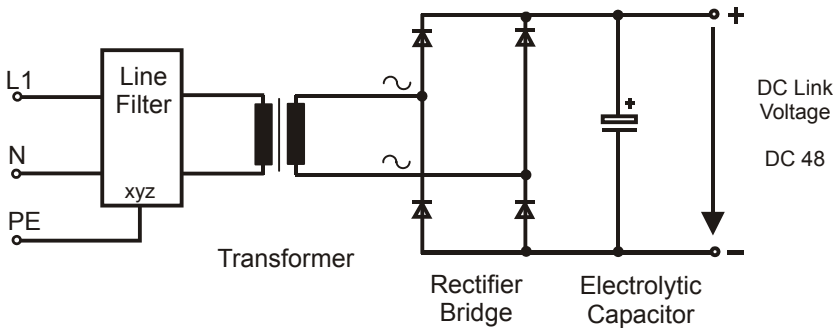


Fig. 7: Configuration of the power supply unit for the motor operation voltage

The power supply unit can be configured with a 1- or 3-phase wiring.

The output of the power supply unit is rated at the output required by the motor:

$$P = \frac{M \cdot n}{9.55} + P_{Losses}$$

Output power P in Watt (W)
Torque M in Nm
Speed n in 1/min
Power dissipation $P_{Dissipation}$ in Watt (W)

The power supply voltage is rated at the required speed and torque:

$$U = U_n + U_M$$

with

$$U_N = \frac{K_E \cdot n}{1000}$$

Counter-EMF U_n in Volt (V)
Back EMF constant K_E in V*min/1000
Speed n in 1/min

Voltage U_M generating the required torque at maximum speed.

By the energy fed back into the JetMove 105, the voltage at the output of the power supply unit can be increased to 60 V. see "Recommendations on preventing overvoltage at braking or lowering a vertical load" on page 46

Between amplifier and power supply unit, significant pulse-like currents of short rise-times are flowing.
In each supply cable, there is an ohmic and an inductive component. If the values are too high, the efficiency of the power supply unit buffer is questionable.
– Blocking capacitors will be thermally overloaded.
– Peak voltages can lead to destruction of the controller board.

From this, the following requirements to the supply cable result:
• Make sure, the cross-section is sufficient.
• Decrease the inductivity by twisting.

Install an external charging capacitor close to the JetMove 105, if the distance the between power supply unit and the JetMove 105 is greater than 20 m.
The charging capacitor must stand a high AC load. Electrolytic capacitors meet this requirement. See Fig. 9.

In order to prevent EMI, the 0 V potential that is close to the power supply unit for motor operation voltage should be connected to earth.

7.1.1 Recommendations on the power supply On/Off switch +Vmot

If the $+V_{MOT}$ power supply is switched on abruptly, the inrush current might reach a value high enough to destroy the motion system. We recommend to place the switch for the motor power supply at the INPUT of the power supply (see Fig. 8), and NOT at its output between power supply and motion system. This way, the current-limiting of the output voltage of the power supply is used for input current limitation of the JetMove 105.

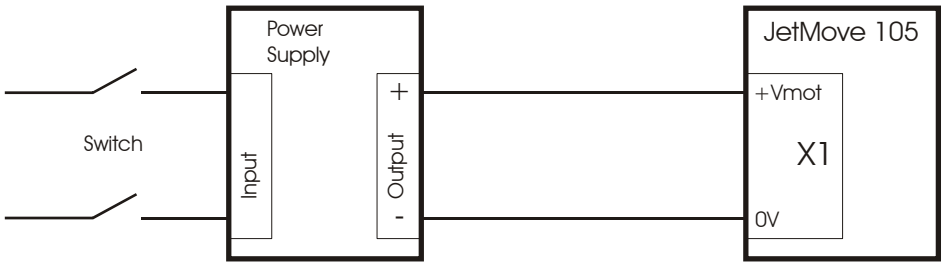


Fig. 8: Terminal X1 - Recommended input current limitation

If the solution just mentioned cannot be put into practice (in case of power supplies that cannot be interrupted, or in case of batteries/accus, for example), an external capacitor of at least 470 µF / 100 V between switch and motion system can be connected, in order to limit the increase of the motor supply voltage.

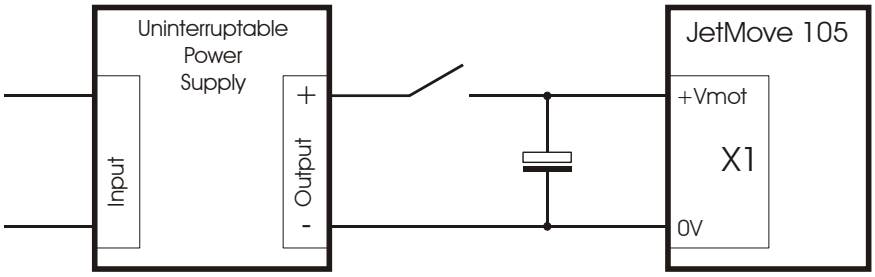


Fig. 9: Terminal X1 - Alternative input current limitation

7.1.2 General remarks

Important!

Recommended wiring of the voltage supply +Vmot

- Always make sure there is a possibility of switching off the power supply externally. Always switch off the power supply before installing the motion system.
- Always limit the inrush current of the motion system. Otherwise the motion system can be destroyed.
- Always use short wires of a large cross-section to connect the voltage supply and the JetMove 105. If the lines are to be longer than 2 meters, use twisted wires for the supply and earthing return line. If wires of more than 20 meters are to be used, apply a capacitor of at least 1,000 µF (set for the maximum possible voltage) close to the X1 terminal.
- If the same power supply is used for multiple motion systems, apply a star-connection the electrical center of which consists of the supply outputs. Connect each motion system to the general motor voltage supply using different wires for either positive or feedback phases.
- Connect the grounding wire / the shielding of the JetMove 105 with a fixed earthing position. The JetMove 105 generates electro-magnetic disturbances if its enclosure has not been earthed.
  Apply a short connection of a large cross-section between the PE of the motion system and the connection to ground. Whenever this is possible, mount the JetMove 105 on a metallized and earthed surface.

7.1.3 Recommendations on preventing overvoltage at braking or lowering a vertical load

At fast braking or reversing the axis, the braking energy is fed back to the motor power supply. This can cause the DC link voltage to increase. If the voltage has reached a limit of 60 V, the overvoltage error is recognized and the motor control deactivated. There are two ways of preventing this behavior:

Possibility 1:

- Connecting an external capacitor:
  The external capacitor must be able to take up the back-fed energy.
  The capacitor must be designed for a voltage of at least 100 V.

- Designing an external capacitor:

$$C = \frac{2E_M}{U_{Max}^2 - U_{Nom}^2} - C_{Int}$$

with
U_{Max} = 60 V
C_{Int} = 200 µF
U_{Nom} = 48 V
E_M: back-fed energy [J]

- Calculating the braking energy in case of a rotatory motor:

$$E_M = \underbrace{\frac{1}{2}(J_M + J_L)2\pi n_M}_{\text{Kinetic energy}} + \underbrace{m_L g(h_1 - h_2)}_{\text{Potential energy}} - \underbrace{3I_M^2 R_{Ph} t_d}_{\text{Switching losses}} - \underbrace{M_L t_d \pi n_M}_{\text{Friction}}$$

with
J_M: Inertia of the motor [kgm^2]
J_L: Inertia load of the motor [kgm^2]
n_M: Motor speed before deceleration [1/s]
m_L: Mass of the load at non-horizontal motion [kg]
g = 9.81 m/s^2
h_1: Height before deceleration [m]
h_2: Height after deceleration [m]
I_M: Motor current during deceleration [A]
R_{Ph}: Resistance of the motor [Ω]
t_d: Delay time [s]
M_L: Friction torque of the motor [Nm]

Calculating the braking energy in case of a linear motor:

$$E_M = \underbrace{\frac{1}{2}(m_M + m_L)v_M^2}_{\text{Kinetic energy}} + \underbrace{(m_M + m_L)g(h_1 - h_2)}_{\text{Potential energy}} - \underbrace{3I_M^2 R_{Ph} t_d}_{\text{Switching losses}} - \underbrace{F_L \frac{t_d \times v_M}{2}}_{\text{Friction}}$$

with

m_M: Motor mass [kg]

m_L: Mass of the load [kg]

v_M: Motor speed before deceleration [m/s]

$g = 9.81\ m/s^2$

h_1: Height before deceleration [m]

h_2: Height after deceleration [m]

I_M: Motor current during deceleration [A]

R_{Ph}: Resistance of the motor [Ω]

t_d: Delay time [s]

F_L: Friction power of the motor [N]

If the calculation described above cannot be carried out because of missing values, a good starting value for the capacitor is 10,000 µF / 100 V.

Possibility 2:

Connecting an external braking resistor:
The motion system leads the back-fed energy to the braking resistance, as soon as the threshold of 55 V has been reached.
The following conditions have to be met before selecting the braking resistance:

1. Limiting the maximum current:

$$R_{Bl} > \frac{U_{Max}}{I_{Peak}}$$

with
U_{Max} = 60 V
I_{Peak} = 16.5 A

2. Limiting by means of the maximum braking power:

$$R_{Bl} < \frac{U_{Bl}^2}{2P_{Bl}}$$

Calculating the braking power:

$$P_{Bl} = \frac{E_M - \frac{1}{2}C(U_{Max}^2 - U_{Bl}^2)}{t_d}$$

with
$C = C_{Ext} + C_{Int}$ and C_{Int} = 200 µF
U_{Max} = 60 V
U_{Bl} = 55 V
E_M: Braking energy (see above)
t_d: Delay time [s]

3. Limiting by means of the average current value:

$$R_{Bl} > \frac{P_{Bl} \cdot t_d}{t_{Cycle} \cdot I_{Nom}^2}$$

with
t_{Cycle}: Time interval between two delays in case of recurring motions
I_{Nom} = 5 A

4. Selection by means of average power and peak value:

$$P_{Av} = \frac{P_{Bl} \cdot t_d}{t_{Cycle}}$$

$$P_{Peak} = \frac{U_{Max}^2}{R_{Bl}}$$

Note 1!

If $\frac{U_{Max}}{I_{Peak}} > \frac{U_{Bl}^2}{2P_{Bl}}$, the braking power must be decremented.
This can either be attained by a longer delay time or by a larger C_{Ext} (external capacitor at the power supply).

Note 2!

If $\frac{P_{Bl} \cdot t_d}{t_{Cycle} \cdot I_{Nom}^2} > \frac{U_{Bl}^2}{2P_{Bl}}$ either the braking power has to be decreased or else the cycle time of the delays has to be increased.

DANGER of hot surfaces!

Caution

The surface of the braking resistor can heat up during operation.

- **During operation or during the cooling-off period after the power has been turned off, do by no means touch the braking resistor .**
- Please make sure that no temperature-sensitive parts have been connected or fastened to the braking resistor.

Note!

Options 1 and 2 can also be combined.

7.2 Voltage Supply

Specification of Terminal X1

- 8-pin screw clamping terminal (type MC 1.5/ 8-ST-3.5)
- Diameter of the cable apt for connecting: 0.14 - 1.5 mm^2 with bootlace ferrules in a plastic sleeve: 0.25 - 1 mm^2
- Bladed screw-driver: 0.4 x 2.5 mm
- Stud torque for the screw clamping terminal: 0.22 Nm

Connecting Cable Specifications

- Cable cross section: 2 * 1 mm² for the motor power supply
- Cable cross section: 1 * 0.5 mm² for the logic power supply
- Material: Copper
- Temperature class: 60 °C
- Stripping length of cores: 6 mm
- Cable shielding: Not required

Voltage Supply		
Terminals X1 on the Amplifier Side	**Signal**	**Specification**
PE	PE conductor	The PE conductor is connected to the enclosure.
$+V_{MOT}$	DC link supply	24 / 48 V DC (12 ... 48 V DC) $I_{max.}$ = 16.5 A No inrush current limitation
$+V_{LOG}$	Power supply of the logic unit	24 V DC (12 ... 40 V DC) $I_{max.}$ = 250 mA at 24 V No inrush current limitation
0V	Zero potential for the power supply	Ground reference for $+V_{MOT}$ and $+V_{LOG}$

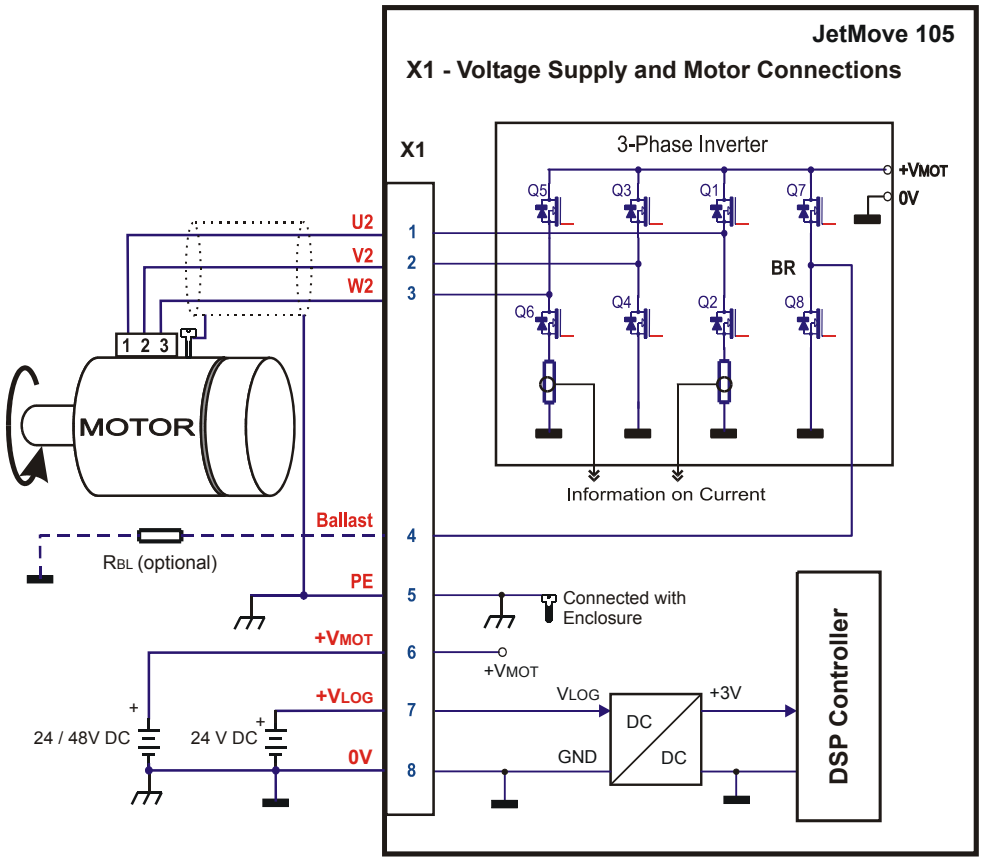


Fig. 10: X1 - Supply voltage

7.3 The Servo Motor

Specification of Terminal X1

- 8-pin screw clamping terminal (type MC 1.5/ 8-ST-3.5)
- Diameter of the cable apt for connecting: 0.14 - 1.5 mm^2 with bootlace ferrules in a plastic sleeve: 0.25 - 1 mm^2
- Bladed screw-driver: 0.4 x 2.5 mm
- Stud torque for the screw clamping terminal: 0.22 Nm

Specification of the Motor Cable

- Cable cross section: up to 4 * 0.75 mm²
- Material: Copper
- Temperature class: 60 °C
- Stripping length of cores: 6 mm
- Cable shielding: Braided copper shield of 80 % coverage min.
- Maximum cable length: 50 m

Motor Connection		
Terminals X1 on the Amplifier Side	**Signal**	**Specification**
U2	Motor phase 1	Motor cable
V2	Motor phase 2	Motor cable
W2	Motor phase 3	Motor cable
BALLAST	Ballast resistor	An optional ballast resistor can be connected between this terminal and ground.
PE	PE conductor	The PE conductor is connected to the enclosure.

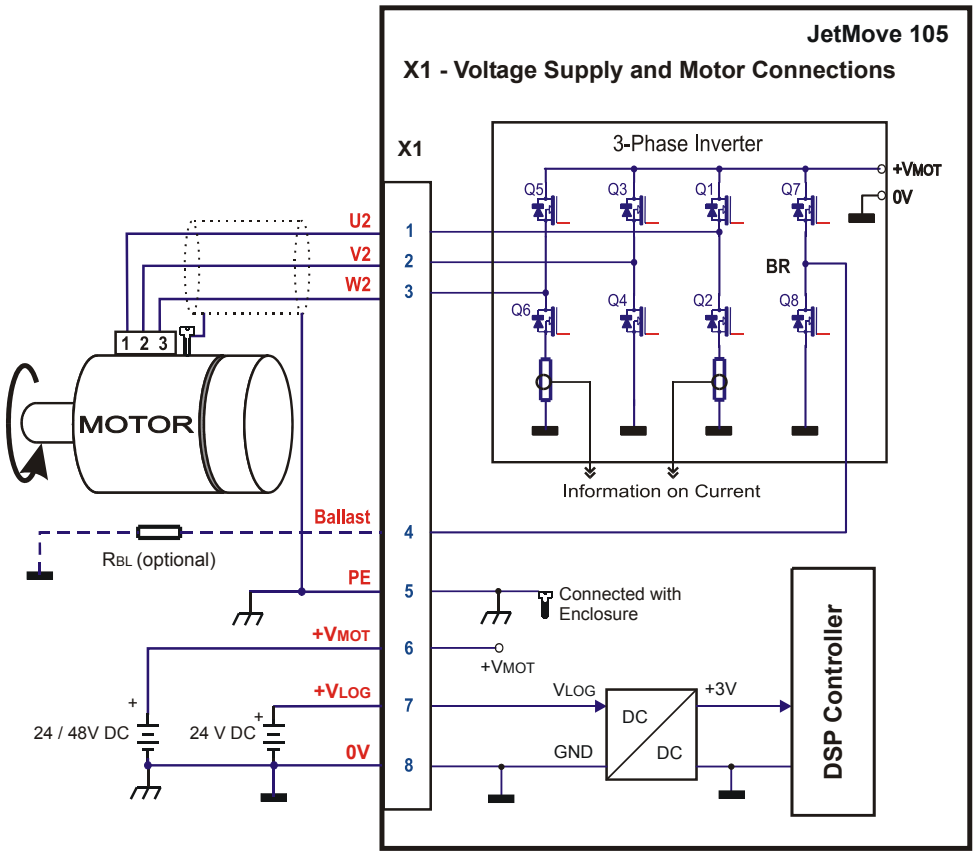


Fig. 11: X1 - Servo motor connection

Important!

Alternative measures to avoid malfunctions of the control system and the motor:

- The brake has to be operated through a separately shielded brake line.

Important!

Measures to avoid oscillation and blocking of the motor:

- Avoid mixing-up of the motor phases, resp. be sure to connect the motor phase cables according to the pin assignment.

There are two motor cabling options:

7.3.1 Motor with male connector

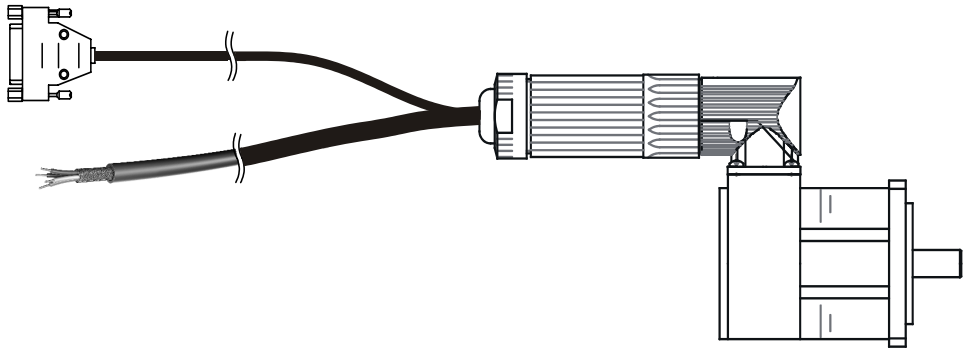


Fig. 12: Motor with male connector

For the power connections and for the feedback, the motor has been equipped with screw clamping terminals. With the help of prefabricated cables, the connection to the JetMove 105 is established (see "Pre-fabricated motor cable with SC mating connector" on page 56 and “Resolver cable with mating connector" on page 68).
Motor specification: S, S-A, S-B or S-X for JH2 motors

7.3.2 Motor with screw clamping terminals and cables with male connectors

Fig. 13: Motor with cables and male connectors

The motor is equipped with screw clamping terminals with cables for power and feedback cables. In the type designation xxx.x,, the cable length is specified in meters. At the cable ends, male connectors have been fixed that correspond to the pre-fabricated JetMove 105 connection cables (see "Pre-fabricated motor cable with SC mating connector" on page 56 and “Resolver cable with mating connector" on page 68).
Motor specification: S4-xxx.x for JH2 and JL1 motors

7.3.3 Motor with screw clamping terminals and cables with male connectors

Fig. 14: Motor with cable and without a male connector

The motor is equipped with screw clamping terminals with cables for power and feedback cables. In the type designation xxx.x,, the cable length is specified in meters. The cable ends have not got a male connector. This way, the motor cable can be connected with the JetMove directly. The feedback cable has to be connected with a SUB-D male connector.
Motor specification: S3-xxx.x for JH2 and JL1 motors

7.3.4 Pre-fabricated motor cable with SC mating connector

The pre-fabricated motor cable is used with the variants “Motor with male connector" on page 54 and “Motor with screw clamping terminals and cables with male connectors" on page 54.

Note!

The suitable mating connector SC (female connector) can be ordered from Jetter AG by supplying the following particulars:

Art. no. 15100070	Motor connector for the Jetter motor series JH2, JH3, JH4, JH5, JL2, JL3, JL4, JK4, JK5, JK6 without brake
Art. no. 15100105	Motor connector for the Jetter motor series JH2, JH3, JH4, JH5, JL2, JL3, JL4, JK4, JK5, JK6 with brake

Note!

The motor cable with the SC mating connector matching the Jetter motor series JH can be obtained from Jetter AG. It is confectioned with the matching motor mating connector and can be ordered by the following cable confection numbers:

Without Brake:

KAB-MOT-0626-xxxx

With Brake:

KAB-MOT.B-0624-xxxx

Mating Connector of the Motor (Solder Side)

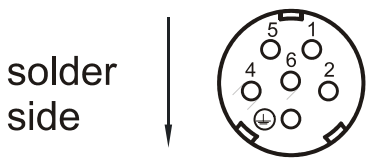
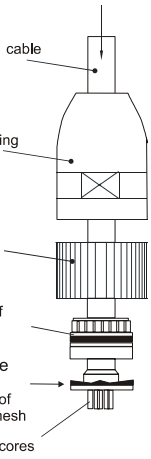
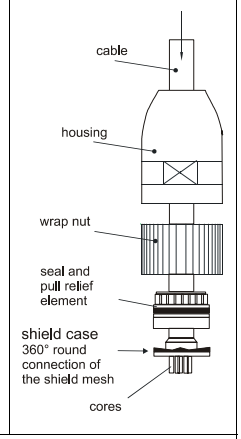


Fig. 15: View on the SC series mating connector of the motor (internal thread M23)

Cable Specification of the Motor Power Cable with Mating Connector SC for JetMove 105

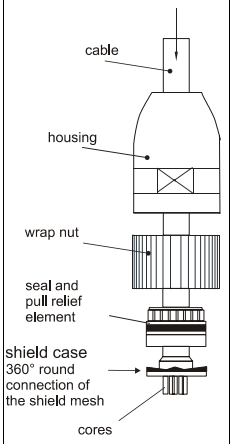
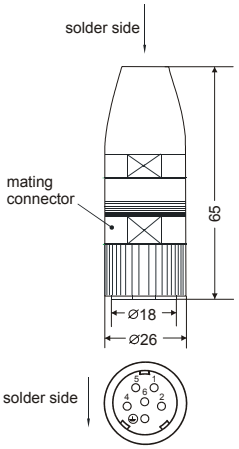
For connection without motor holding brake

<table>
<tr><th colspan="4">Motor Power Cable KAY-0626-xxxx</th></tr>
<tr><td>Terminals of the JetMove 105</td><td colspan="2">Shielding</td><td>Mating connector of the motor (female, solder side)</td></tr>
<tr><td>4 x 0.75 mm^2

The wires are equipped with wire end ferrules.</td><td colspan="2">Shielded, highly flexible 4-wire cable with PE.</td><td rowspan="2"> 
</td></tr>
<tr><td colspan="2">  </td><td> 
</td></tr>
<tr><td></td><td colspan="2">Connect both sides of the shield with the greatest possible surface area!
Use metallized enclosure only!</td><td></td></tr>
<tr><td>Pin</td><td>Wire number</td><td>Signal</td><td>Pin</td></tr>
<tr><td>X1.U2</td><td>1</td><td>Phase 1</td><td>1</td></tr>
<tr><td>X1.V2</td><td>2</td><td>Phase 2</td><td>5</td></tr>
<tr><td>X1.W2</td><td>3</td><td>Phase 3</td><td>2</td></tr>
<tr><td>X1.PE</td><td>yellow-green</td><td>PE conductor</td><td>  </td></tr>
</table>

Dimensions of the motor mating connector are specified in millimeters.

For connection with motor holding brake

Motor Power Cable KAY-0624-xxxx			
Terminals of the JetMove 105	**Shielding**		**Mating connector of the motor (female, solder side)**
7 x 0.75 mm^2 The wires are equipped with wire end ferrules. 	Shielded, highly flexible 6-wire cable with PE.		
	Connect both sides of the shield with the greatest possible surface area! Use metallized enclosure only!		
Pin	**Wire number**	**Signal**	**Pin**
X1.U2	1	Phase 1	1
X1.V2	2	Phase 2	5
X1.W2	3	Phase 3	2
X1.PE	yellow-green	PE conductor	⏚
X62.2	5	Brake +	6
X62.1	4	Brake -	4

Dimensions of the motor mating connector are specified in millimeters.

7.3.5 Motor cable permanently fixed to the motor

The motor cable is used for the variant “Motor with screw clamping terminals and cables with male connectors" on page 55.

Specification of the Motor Power Cable without Mating Connector

For connection without motor holding brake

Motor Power Cable Fixed to the Motor		
Terminals of the JetMove 105	**Shielding**	**Motor**
7 x 0.75 mm^2 The wires are equipped with wire end ferrules.	Shielded, highly flexible 6-wire cable with PE. 	
		Connect shield with the greatest possible surface area!
Pin	**Wire number**	**Signal**
X1.U2	1	Phase 1
X1.V2	2	Phase 2
X1.W2	3	Phase 3
X1.PE	yellow-green	PE conductor

For connection with motor holding brake

Motor Power Cable Fixed to the Motor		
Terminals of the JetMove 105	**Shielding**	**Motor**
7 x 0.75 mm^2 The wires are equipped with wire end ferrules.	Shielded, highly flexible 6-wire cable with PE.	
		
		Connect shield with the greatest possible surface area!
Pin	**Wire number**	**Signal**
X1.U2	1	Phase 1
X1.V2	2	Phase 2
X1.W2	3	Phase 3
X1.PE	yellow-green	PE conductor
X62.2	4	Brake +
X62.1	5	Brake -

7.4 Brush-Equipped DC Motor

Specification of Terminal X1

- 8-pin screw clamping terminal (type MC 1.5/ 8-ST-3.5)
- Diameter of the cable apt for connecting: 0.14 - 1.5 mm^2 with bootlace ferrules in a plastic sleeve: 0.25 - 1 mm^2
- Bladed screw-driver: 0.4 x 2.5 mm
- Stud torque for the screw clamping terminal: 0.22 Nm

Specification of the Motor Cable

- Cable cross section: up to 2 * 1 mm²
- Material: Copper
- Temperature class: 60 °C
- Stripping length of cores: 6 mm
- Cable shielding: Braided copper shield of 80 % coverage min.
- Maximum cable length: 50 m

Motor Connection		
Terminals X1 on the Amplifier Side	**Signal**	**Specification**
U2	Motor phase +	Motor cable
V2	Motor phase -	Motor cable
BALLAST	Ballast resistor	An optional ballast resistor can be connected between this terminal and ground.
PE	PE conductor	The PE conductor is connected to the enclosure.

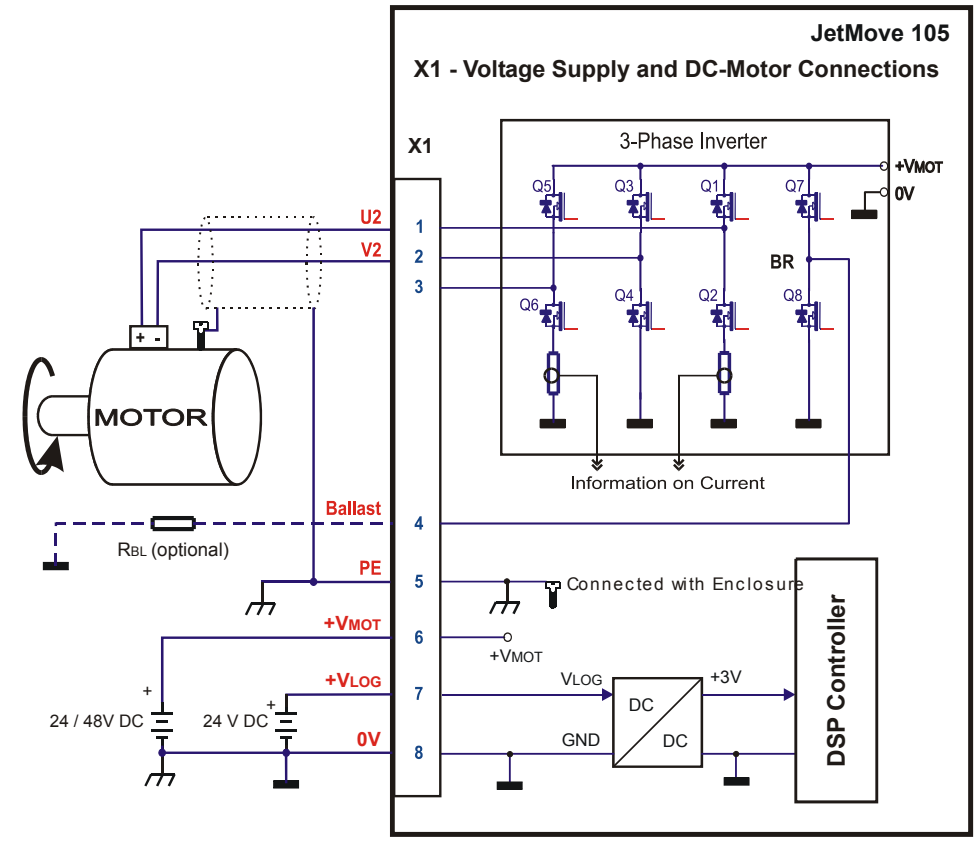


Fig. 16: X1 - DC motor connection

Important!

Alternative measures to avoid malfunctions of the control system and the motor:

- The brake has to be operated through a separately shielded brake line.

7.5 2-Phase Stepper Motor

Specification of Terminal X1

- 8-pin screw clamping terminal (type MC 1.5/ 8-ST-3.5)
- Diameter of the cable apt for connecting: 0.14 - 1.5 mm^2 with bootlace ferrules in a plastic sleeve: 0.25 - 1 mm^2
- Bladed screw-driver: 0.4 x 2.5 mm
- Stud torque for the screw clamping terminal: 0.22 Nm

Specification of the Motor Cable

- Cable cross section: up to 4 * 1 mm²
- Material: Copper
- Temperature class: 60 °C
- Stripping length of cores: 6 mm
- Cable shielding: Braided copper shield of 80 % coverage min.
- Maximum cable length: 50 m

Motor Connection		
Terminals X1 on the Amplifier Side	**Signal**	**Specification**
U2	Motor phase 1+	Motor cable
V2	Motor phase 1 -	Motor cable
W2	Motor phase 2+	Motor cable
Ballast	Motor phase 2 -	Motor cable
PE	PE conductor	The PE conductor is connected to the enclosure.

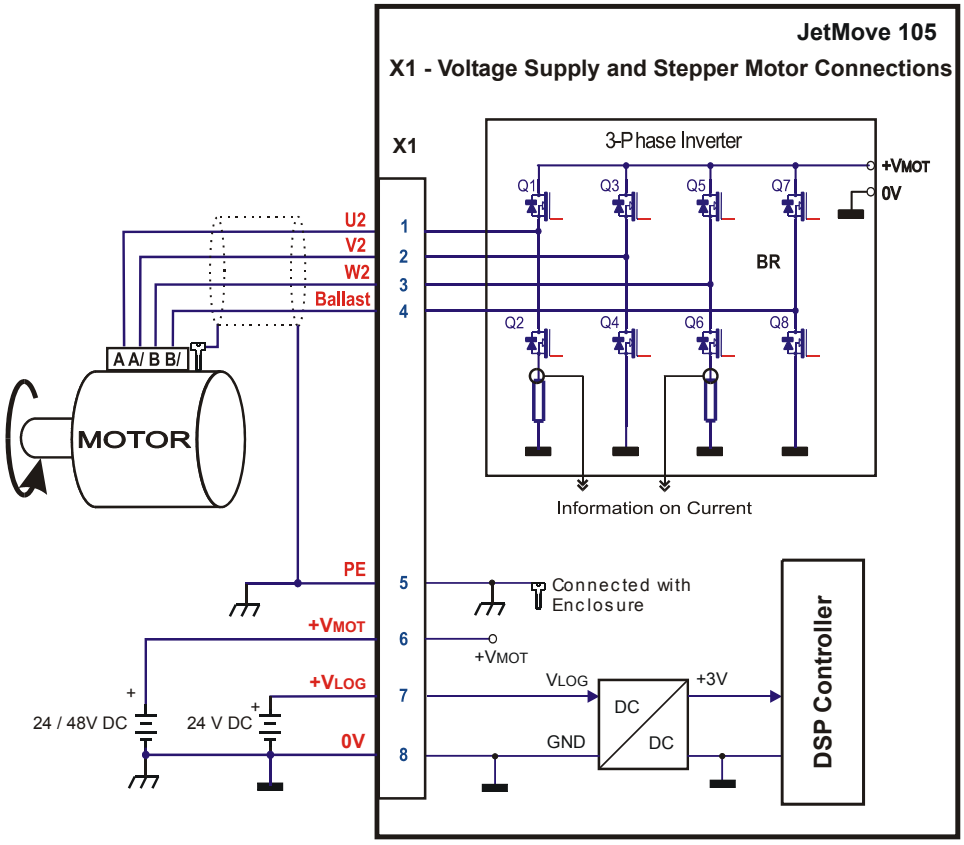


Fig. 17: X1 - Stepper motor connection

Important!

Alternative measures to avoid malfunctions of the control system and the motor:

- The brake has to be operated through a separately shielded brake line.

7.5.1 Stepper motor control

The stepper motor at the JetMove 105 is controlled by sine-wave commutation (maximum microstep mode). Thus, the noise typical for classic stepper motor controls cannot be heard, not even at lowest speeds.
As any other motor types connected to JetMove amplifiers, the stepper motor is also programmed in millimeters or degrees instead of steps, related to load.

The motor speed can be calculated by the following formula:

$$n = \frac{\frac{60s}{min}}{\frac{360°}{1\,rev.}} \cdot v$$

Speed n in rev/min
Speed v in °/s

The JetMove 105 has been designed for bipolar usage, i.e. it is possible to let the current flow through the motor winding in both directions. For this purpose, a bridge connection as shown in Fig. 18 is fit best.

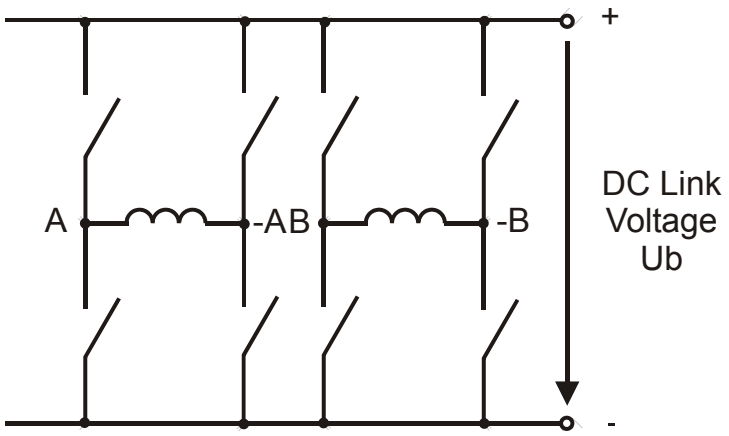


Fig. 18: Bipolar switching for 2-phase-stepper motors

This way it is possible to limit the number of connections between motor control and motor to two per phase (plus PE) with the help of series or parallel connection of the partial windings in or at the motor.

In order to achieve reliable positioning, a defined constant moment must be mustered up to a speed value as high as possible.
This must be achieved by adequate controlling. The procedure applied here is constant current operation with vector control. Constant current operation has been made possible by the development of switching controller technology and by making efficient and fast transistors available. Vector control is made use of within the JetMove 2xx series for servo motor control.

The following entirety of vectors limit constant current operation:

1. Independent of the speed, a certain voltage is needed for having the set current overcome the resistance of the phase. :

$$U_1 = R \cdot I$$

Where:
Continuous rated current I in Ampere [A]
Resistance R per phase in Ohm [Ω]

2. Dependent on the speed, a certain voltage is needed for reversing the polarity of the motor current. This voltage is calculated as follows:

$$U_2 = \omega \cdot L \cdot I$$

Where:
Continuous rated current I in Ampere [A]
Inductivity L per phase in [Vs/A]
Angular velocity ω in [rad/s]

The angular velocity ω of a stepper motor

$$\omega = 2\pi f = 2\pi \cdot Z_P \cdot \frac{\text{min}}{60\text{s}} \cdot n = 2\pi \cdot Z_P \cdot \frac{\text{rev.}}{360°} \cdot v$$

Where:
Pole pair number Z_P = 50
Speed n in [rev/min]
Angular velocity v in [°/s]

3. When the motor is rotating, the influence of the EMF (Electro-Motive Force) can be realized as well. It is opposed to the operating voltage and decreases the effective voltage during power build-up; power build-up, which is speeded up by the EMF, though.

Theoretically, the motor can be driven to about the same speed which is needed for the vector sum U_S to just compensate the phase voltage. Above this speed, the motor cannot be driven any more.

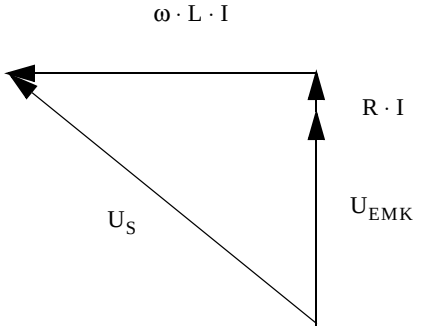


Fig. 19: Addition of voltage in a synchronous machine

The maximum phase voltage is calculated out of the DC link voltage as follows:

$$U_S = \frac{+V_{MOT}}{\sqrt{2}}$$

Thus, the maximum speed depends on the operating voltage. For this reason, the operating voltage should, in general, amount to 48 V.

7.5.2 Acceleration and deceleration

If a stepper motor without actual position feedback is used, exceeding the maximum possible torque of the motor must by all means be inhibited. Therefore, acceleration and deceleration should be carried out by linear ramps.

A linear ramp results in constant acceleration of motor and load. For this purpose, a constant motor torque is required. The degree of a possible acceleration depends on the available torque.

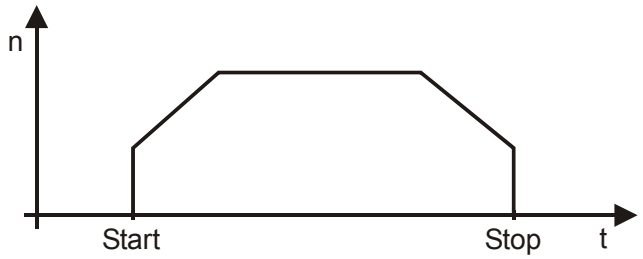


Fig. 20: Acceleration by linear ramp

7.6 Connection of the Resolver

7.6.1 Specification

Specification of the Connector for Terminal X61 (ENCODER)

- 15-pin high density SUB-D connector (male)
- Metallised enclosure

Specification of the Resolver Cable

- Cable cross section: 3 * 2 * 0.14 mm² min.
- Cores have to be shielded and twisted in pairs and must be included in an overall shielding.
- The shield has to be connected to the connector enclosures on both ends of the cable with the greatest possible surface area.
- Material: Copper
- Temperature class: 60 °C
- Maximum cable length: 50 m

7.6.2 Resolver cable with mating connector

The pre-fabricated resolver cable is used with the variants “Motor with male connector" on page 54 and “Motor with screw clamping terminals and cables with male connectors" on page 54..

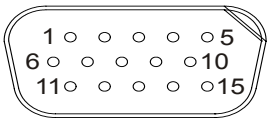
Note!

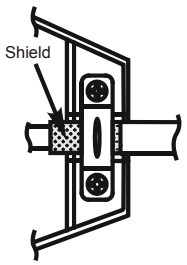
The resolver respectively HIPERFACE mating connector of the synchronous servo motor series JH, JL and JK can be ordered from Jetter AG by supplying the following particulars:

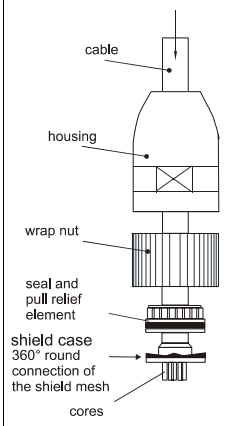
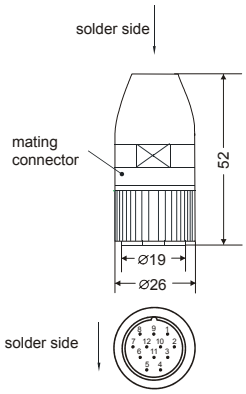
Article # 15100069 Resolver / HIPERFACE

The complete resolver cable connecting the servo amplifier JetMove 105 and the synchronous servo motor series JL1 and JH2 can be obtained from Jetter AG. The resolver cable can be ordered by submitting the following cable specifications and the respective cable length in cm:

KAB-ENC.RS-0623-xxxx For the servo amplifier series JetMove 105

<table>
<tr><th colspan="4">Resolver Cable KAY-0623-xxxx</th></tr>
<tr><th>JetMove 105 (SUB-D connector X61)</th><th colspan="2">Shielding</th><th>Motor (Resolver) (female, solder side)</th></tr>
<tr><td rowspan="2"> 

Attaching screws must have a metric thread!</td><td> 

3 * 2 * 0.14 mm^2</td><td> 
</td><td rowspan="2"> 
</td></tr>
<tr><td colspan="2">Connect shield with the greatest possible surface area!
Use metallized enclosure only!</td></tr>
<tr><th>Pin</th><th>Signal</th><th>Core color</th><th>Pin</th></tr>
<tr><td>4</td><td>S1 (cosine +)</td><td>brown</td><td>1</td></tr>
<tr><td>14</td><td>S3 (cosine -)</td><td>white</td><td>2</td></tr>
<tr><td>15</td><td>S4 (sine -)</td><td>yellow</td><td>3</td></tr>
<tr><td>5</td><td>S2 (sine +)</td><td>green</td><td>4</td></tr>
<tr><td>9</td><td>R1 (exciter winding +)</td><td>pink</td><td>5</td></tr>
<tr><td>10</td><td>R2 (exciter winding -)</td><td>gray</td><td>6</td></tr>
<tr><td></td><td>unassigned</td><td>-</td><td>7 - 12</td></tr>
</table>

Dimensions of the resolver mating connector are specified in millimeters.

Mating Connector of the Resolver (Solder Side)

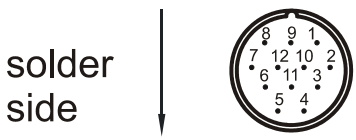
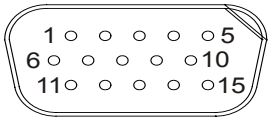
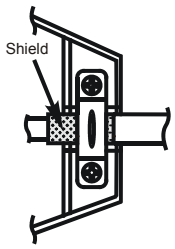


Fig. 21: RC series mating connector of the resolver (internal thread M23)

7.6.3 Resolver cable without mating connector

The resolver cable is used for the variant “Motor with screw clamping terminals and cables with male connectors" on page 55.

Resolver Cable at the Motor		
JetMove 105 (SUB-D connector X61)	**Shielding**	**Motor (Resolver)**
 		
Attaching screws must have a metric thread!	Connect shield with the greatest possible surface area! Use metallized enclosure only!	
Pin	**Signal**	**Core color**
4	S1 (cosine +)	brown
14	S3 (cosine -)	white
5	S2 (sine +)	yellow
15	S4 (sine -)	green
9	R1 (exciter winding +)	pink
10	R2 (exciter winding -)	gray
	Thermoswitch	red
	Thermoswitch	blue

7.7 Sin-Cos Encoder Connection

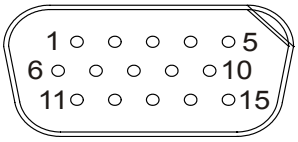
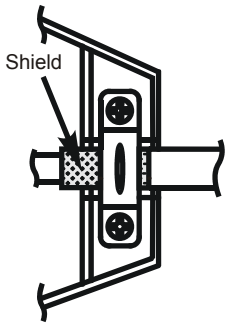
7.7.1 Specification

Specification of the Connector for Terminal X61 (ENCODER)

- 15-pin high density SUB-D connector (male)
- Metallised enclosure

Specification of the Sin-Cos Encoder Cable

- Cable cross section: 3 * 2 * 0.14 mm² + 2 * 0.25 mm² min.
- 2 * 0.25 mm² has to be used for the power supply unit and for GND
- Twisted-pair cables shielded with the all-over shield must be used; the signal lines must also be twisted in pairs:
  Sine + and reference sine
  Cosine + and reference cosine
  Index + and reference index
  0 V and voltage supply
- The shield has to be connected to the connector enclosures on both ends of the cable with the greatest possible surface area.
- Material: Copper
- Temperature class: 60 °C
- Maximum cable length: 50 m

Sin-Cos Encoder Cable		
JetMove 105 (SUB-D connector X71 / X81)	**Shielding**	**Cable specification**
 Attaching screws must have a metric thread!	 Connect shield with the greatest possible surface area! Use metallized enclosure only!	Maximum cable length: 100 m
Pin	**Signal**	
5	Sine +	
15	Reference sine	
4	Cosine +	
14	Reference cosine	
7	Index +	
8	Reference index	
1	Voltage output (5 Volt)	I_{max}= 350 mA
6	Voltage output (24 Volt)	I_{max}= 300 mA
11	0 V	

Note 1.1!

Supply voltage +5 V at the JetMove 105:
Due to conduction loss, a lower voltage might be supplied to the encoder.

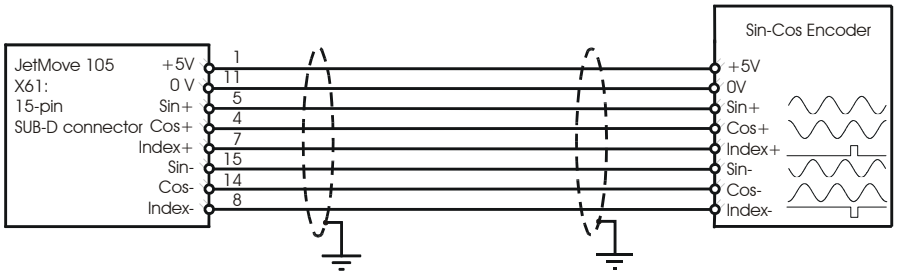


Fig. 22: Sin/Cos encoder connection

7.8 Connection of the Incremental Encoder

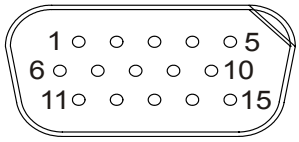
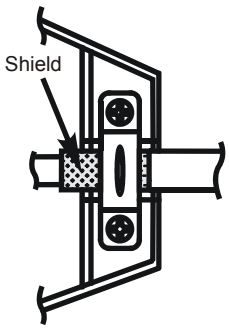
7.8.1 Specification

Specification of the Connector for Terminal X61 (ENCODER)

- 15-pin high density SUB-D connector (male)
- Metallised enclosure

Specification of the Incremental Encoder Cable

- Cable cross section: 3 * 2 * 0.14 mm² + 2 * 0.25 mm² min.
- 2 * 0.25 mm² has to be used for the power supply unit and for GND
- Twisted-pair cables shielded with the all-over shield must be used; the signal lines must also be twisted in pairs:
  K0 + and K0 -
  K1 + and K1 -
  K2 + and K2 -
  0 V and voltage supply
- The shield has to be connected to the connector enclosures on both ends of the cable with the greatest possible surface area.
- Material: Copper
- Temperature class: 60 °C
- Maximum cable length: 50 m

Incremental Encoder Cable		
JetMove 105 (SUB-D connector X61)	**Shielding**	**Specification of the cable**
 Attaching screws must have a metric thread!	 Connect shield with the greatest possible surface area! Use metallized enclosure only!	Encoder signal: 5 V difference signal or 5 V single-ended Maximum cable length: 100 m
Pin	**Signal**	
2	K1+	
12	K1-	
3	K2	
13	K2-	
7	K0	
8	K0-	
1	Voltage output (5 Volt)	I_{max}= 350 mA
6	Voltage output (24 Volt)	I_{max}= 300 mA
11	0 V	

Note 1!

Supply voltage +5 V at the JetMove 105:
Due to conduction loss, a lower voltage might be supplied to the encoder.

Note 2!

Bus terminating resistor:
In case of differential connection, a bus terminating resistor of 120 each has to be set at a cable length of 10 m or more Ω between K0+ and K0-, K1+ and K1-, as well as K2+ and K2- .

Note 3!

Single-ended connection:
In case of single-ended connection, only signals K0+, K1+ and K2+ are used. Signals K0-, K1- and K2- must not be connected.

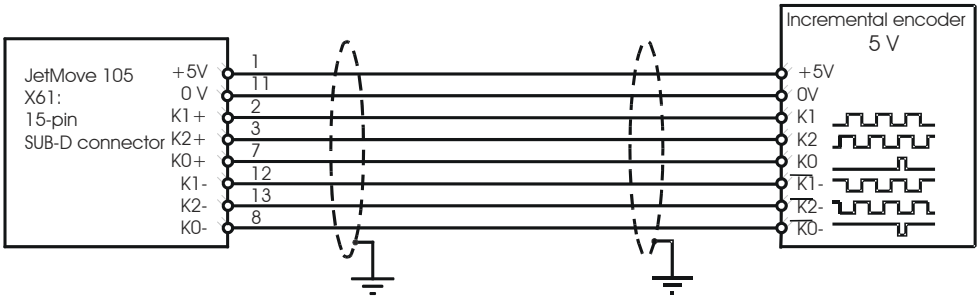
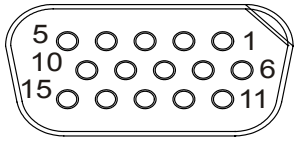


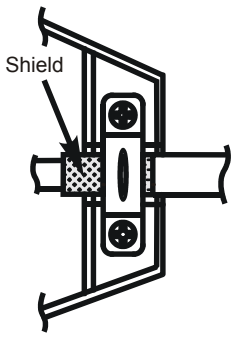
Fig. 23: Incremental encoder connection

7.9 Digital and Analog Inputs and Outputs

Specification of the Female Connector for Male Connector X62 (IN/OUT)

- 15-pin high density SUB-D connector (female)
- Metallised enclosure
- For using the analog inputs, shielding is required

<table>
<tr><th colspan="4">Input/Output Cable</th></tr>
<tr><th colspan="2">JetMove 105 (SUB-D female connector X62)</th><th>Shielding</th><th>Specification of the cable</th></tr>
<tr><td colspan="2"> 

Attaching screws must have a metric thread!</td><td> 
</td><td>If the analog input is used:

Connect shield with the greatest possible surface area!
Use metallized enclosure only!</td></tr>
<tr><th>Pin</th><th>Signal</th><th>Function</th><th>Specification</th></tr>
<tr><td>1</td><td>0 V</td><td rowspan="2">Contacts for the motor brake

The brake output can be operated either by the control program or by the operating system of the JetMove 105 at release of the motor current.

The JetMove 105 is equipped with an internal freewheeling diode.</td><td rowspan="2">The internal semiconductor switch connects the $+V_{LOG}$ with the output pin.

I_{max} = DC 0.5 A

Contact: N/O

These connections are only for devices having got the same reference to ground as the power supply of the logic.</td></tr>
<tr><td>2</td><td>Brake</td></tr>
<tr><td>3</td><td>Analog input+</td><td>Analog signal</td><td>0 - 10 V to pin 4</td></tr>
<tr><td>4</td><td>Analog input-</td><td>Reference of the analog signal</td><td>not connected with 0 V of the motion system</td></tr>
<tr><td>5 - 6</td><td>0 V</td><td>Ground</td><td></td></tr>
</table>

7- 9	Reserved		Keep unoccupied
10	0 V	Ground	
11	Hardware enable for the power supply of the motor (input)	• At this input, a high signal is necessary for power supply of the motor. (This signal must have been applied before carrying out the software enable) • A low signal de-energizes the motor immediately.	• DC 20 .. 30 V • Input resistance: 3 KOhm • Operating point: < 4 V low, > 14 V high
12	Reference switch (input)	• Depending on the parameter setting, this input is used for reference run	• DC 20 .. 30 V • Input resistance: 3 KOhm • Operating point: < 4 V low, > 14 V high NC or NO contact
13	Positive limit switch (input)	• Depending on the parameter setting, this input is used as a positive limit switch	• DC 20 .. 30 V • Input resistance: 3 KOhm • Operating point: < 4 V low, > 14 V high NC or NO contact
14	Negative limit switch (input)	• Depending on the parameter setting, this input is used as a negative limit switch	• DC 20 .. 30 V • Input resistance: 3 KOhm • Operating point: < 4 V low, > 14 V high NC or NO contact
15	Digital input	• Depending on the parameter setting, this input can be used for quick stop, position capture or referencing without stop.	• DC 20 .. 30 V • Input resistance: 3 KOhm • Operating point: < 4 V low, > 14 V high

7.10 Jetter System Bus

The JetMove 105 is interlinked with the controller, additional JetMove amplifiers, or Jetter peripheral modules by means of the Jetter system bus. The system bus input BUS-IN is a 9-pin male SUB-D connector, and the bus output BUS-OUT is a 9-pin female SUB-D connector.

7.10.1 Jetter system bus cable specification

Specification of Connectors

On the BUS-OUT (X19) side
- 9-pin male SUB-D connector
- Metallised enclosure

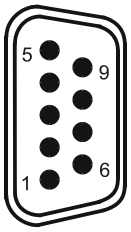
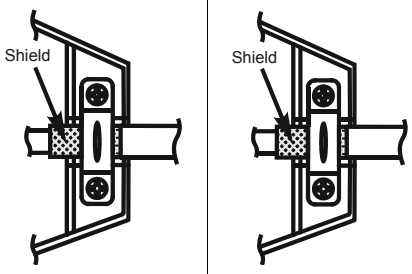
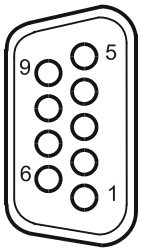
On the BUS-IN (X18) side
- 9-pin female SUB-D connector
- Metallised enclosure

System Bus Cable Specification

The following minimum requirements apply to the manufacture of the system bus cable:

System Bus Cable - Technical Data		
Function	**Description**	
Core cross-sectional area	1 MBaud:	0.25 - 0.34 mm^2
	500 kBaud:	0.34 - 0.50 mm^2
	250 kBaud:	0.34 - 0.60 mm^2
	125 kBaud:	0.50 - 0.60 mm^2
Cable capacitance	60 pF/m max.	
Resistivity	1 MBaud:	70 Ω/km max.
	500 kBaud:	60 Ω/km max.
	250 kBaud:	60 Ω/km max.
	125 kBaud:	60 Ω/km max.
Number of cores	5	
Shielding	Complete shielding, no paired shielding	
Twisting	Core pair CL and CH twisted	

Permitted Cable Lengths			
Baud Rate	**Max. Cable Length**	**Max. Tap Line Length**	**Max. Overall Tap Line Length**
1 MBaud	30 m	0.3 m	3 m
500 kBaud	100 m	1 m	39 m
250 kBaud	200 m	3 m	78 m
125 kBaud	200 m	-	-

System Bus Cable: Cable Conf # 0530		
	Shielding	
		
BUS-OUT	Connect shield with the greatest possible surface area! Use metallized enclosure only!	**BUS-IN**
Pin	**Signal**	**Pin**
1	CMODE0	1
2	CL	2
3	GND	3
4	CMODE1	4
5	TERM	5
6	Unassigned	6
7	CH	7
8	Unassigned	8
9	Do not connect	9

8 Status Monitoring

The amplifier LEDs indicate the operating status of the digital servo amplifier.

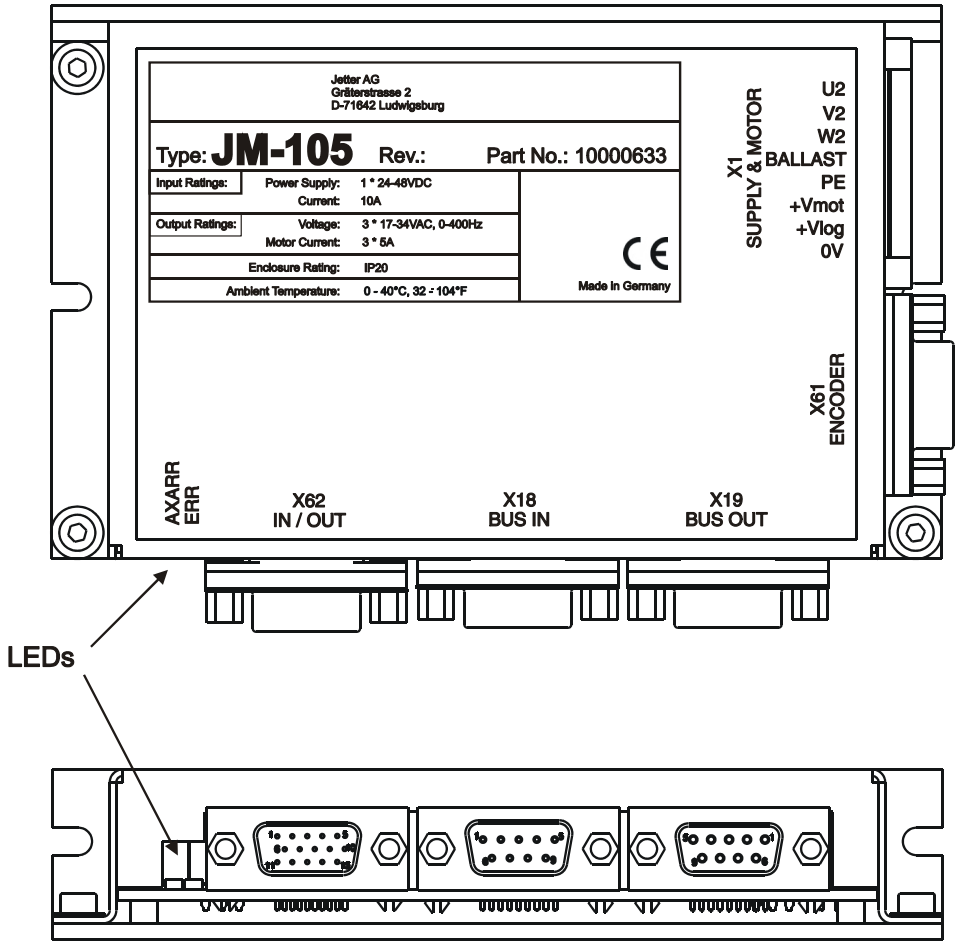


Fig. 24: Status monitoring at the JetMove 105

LEDs at the JetMove 105			
LED	**Color**	**Status**	**Meaning**
Operating System is Active:			
AXARR	Green	Is lit	Axis is standing still (speed = 0)
ERR	Red	Is lit	An error has occurred. The drive controller is locked, error can be acknowledged.
Boot-Phase:			
AXARR	Green	Off	
ERR	Red	Is lit for 1 s	The operating system is being checked.
Operating System Update:			
AXARR	Green	Flashing	The operating system is being programmed.
ERR	Red	Is lit	The operating system update is active.

Note!

The ERR display of the amplifier indicates the error status of the digital servo amplifiers JetMove 105. The range of error statuses is displayed in the motion setup section.

9 Diagnostics

9.1 Error Messages

Note!

The ERR display of the amplifier indicates the error status of the digital servo amplifiers JetMove 105. The range of error statuses is displayed in the motion setup section.

Error Message Table JetMove 105

Error Number	Error type	Description	Response to Errors	Troubleshooting
F 00	Hardware error	Internal hardware defect	– Immediate controller disable	– Cut drive controller from power lines – Return the amplifier for repair
F 04	Overvoltage in the DC link	A DC link voltage of> 60 V has been detected	– Immediate controller disable	– Check input voltage supply – If the motor is used as generator, reduce the regenerating power. – Acknowledge the error
F 05	Current overload	The output current has been greater than 2.5 x the rated current or ground fault during operation	– Immediate controller disable	– Check cable and motor for a short circuit and ground fault – Check current control parameters. If necessary, correct parameters – Acknowledge the error
F 07	Overtemperature of the device	The amplifier has reached the maximum temperature	– Immediate controller disable	– Let the amplifier cool down – After cooling down, acknowledge failure – Reduce power of drive system
F 09	Encoder failure	Encoder breakage or initialisation error of the encoder	– Immediate controller disable	– For extended diagnostics purposes use motion setup – Check the encoder line and all plug-in connections – Acknowledge the error

Error Message Table JetMove 105				
Error Number	**Error type**	**Description**	**Response to Errors**	**Troubleshooting**
F 10	Overspeed	The actual shaft speed has exceeded a value of 1.25 x maximum speed.	– Immediate controller disable	– Check motor and encoder connections – Check speed controller parameters. If necessary, modify parameters – Acknowledge the error
F 11	Current overrange	A current temporarily too high has been detected	– Immediate controller disable	– Reduce K_p of the current controller by 10 to 20 % – Acknowledge the error
F 15	Hardware enable is missing	The software enable is given without a hardware enable.	– Immediate controller disable	– Disable the drive by means of the software – Acknowledge the error
F 17	Trip of software limit switch	Actual position is outside the range of software limits and software limit switches are active	– Stop at max. current (max. torque)	– Check target position – Acknowledge the error – Run axis back within the software limits (monitoring the software limit switches is activated automatically when the axis has returned to this range)
F 18	Hardware limit switch is active	One hardware limit switch is active	– Stop at max. current (max. torque)	– Check target position – Check reference position – Acknowledge the error – Run axis back within the hardware limits (monitoring the hardware limit switches is active automatically when the axis leaves the switch)
F 20	Undervoltage in the DC link voltage	The DC link voltage is less than the minimum value (default: 10 V)	– Stop by emergency stop ramp	– Check the voltage of the power line – Check the parameter "U_{ZK} min. trip" – Acknowledge the error
F 21	Overvoltage in the DC link voltage	The DC link voltage has exceeded the maximum value (default: 60 V)	– Stop by emergency stop ramp	– Check the voltage of the power line – In regenerative braking mode, reduce braking power – Acknowledge the error

Error Message Table JetMove 105				
Error Number	**Error type**	**Description**	**Response to Errors**	**Troubleshooting**
F 22	Drive has been stalled	The drive could not overcome the n = 0 threshold within the time limit specified by the parameter "blocking-tripping time"	– Immediate controller disable	– Eliminate the cause of stalling – Acknowledge the error
F 23	Tracking error	The tracking error has exceeded the limit defined in the parameter "tracking error limit" for the time specified in "tracking window time"	– Stop by emergency stop ramp	– Check the drive mechanism – Check steepness of acceleration/ deceleration ramps and amplifier parameters in relation to the parameters "tracking error limit" and "tracking window time" – Acknowledge the error
F30	I²t error	The average power loss of the motor was more than the max. value configured by nominal motor current, overload factor and motor time constant Refer to “I²t calculation" on page 38.	– Immediate controller disable	– Let the motor cool down – Acknowledge the error – Check the configuration of nominal motor current, overload factor and motor time constant – Reduce the average load of the motor
F38	Asymmetric encoder signal	The analog sine-cosine signals have not got the same amplitude	– Immediate controller disable	– Check wiring or encoder signals – Acknowledge the error
F39	Error at commutation finding	Measuring the commutation offset could not be completed with results being guaranteed.	– Immediate controller disable	– Check parametering – Check wiring or encoder signal – Acknowledge the error
F40	Overload of motor brake	The internal semiconductor switch signals overload (current >> 0.5 A).	– Stop by emergency stop ramp	– Check wiring or motor brake – Acknowledge the error

9.2 Warnings

If the ERR-LED is flashing, one or several warnings have been recognized. In the motion setup, or through querying by means of motion instructions in the controller programs, the warnings can be checked.

10 Wiring Diagrams

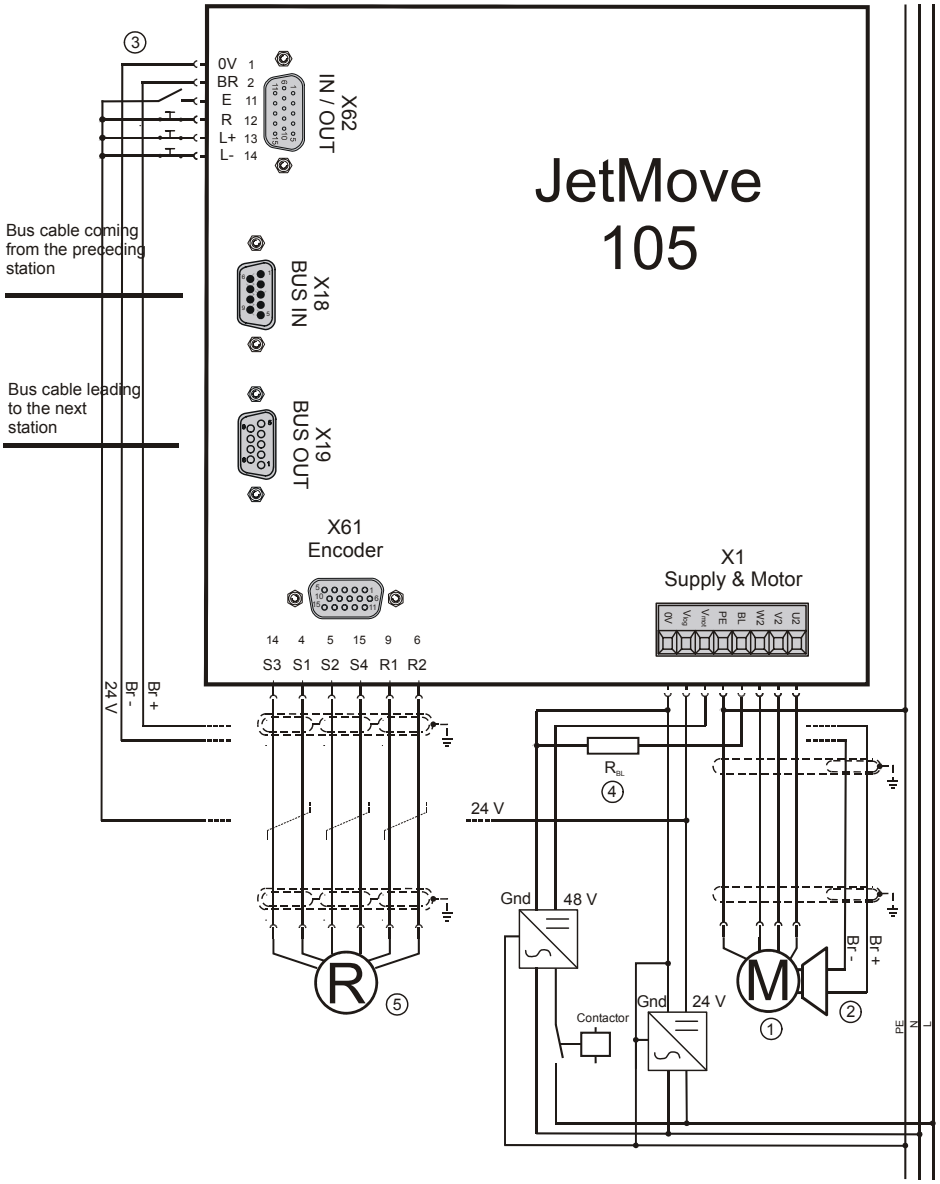


Fig. 25: Wiring diagram of the JetMove 105

Also refer to chapter 7 "Description of Connections", page 43.

Key to the Wiring Diagram:

1	Motor
2	Motor brake (optional)
3	If a motor brake is applied, an external free-wheeling diode has to be connected.
4	Ballast resistor
5	Position encoder (resolver or sin/cos encoder)

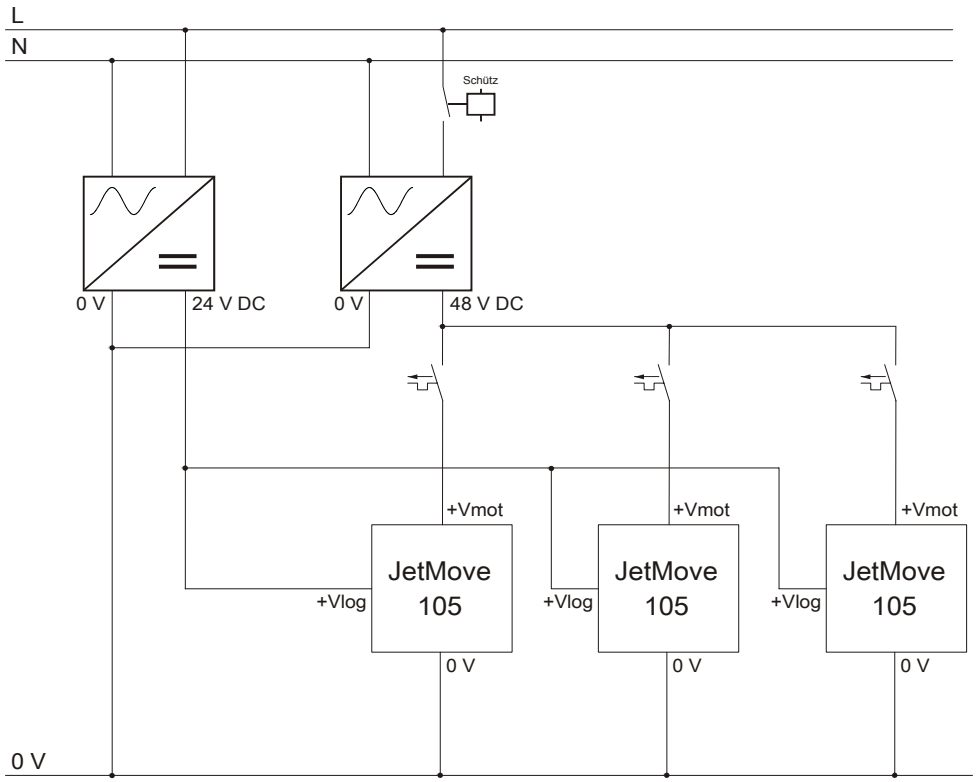


Fig. 26: The usage of short circuit breakers when several JetMove 105 are connected

The short circuit breakers have to be designed according to the cable cross-section.

11 Ordering Information

11.1 Document Survey

The documents listed below have been supplied on the website of Jetter AG at http://www.jetter.de/Service Center for download.

Programming

jm2xx_at_jetcontrol_bi_xxxx_user_information.pdf
Register description and parametering example
Article no.: 60868237

11.2 Device

Designation	Description	Article #
JM-105	Digital Servo Amplifier	10000633

11.3 Motor Power Cables With Mating Connector SC

Connecting cables for Jetter motors without brake:

The motor cables (for motors without brake) of the designation KAY-0626-xxxx can be ordered in the following standard lengths in meters:

1	1.2	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5
7	7.5	8	9	10	11	12	13	14	15	16	17	18
20	22	24	25	30	50							

The order number xxxx designates the length in cm.
Example: A motor cable of 5 meters length has got the designation KAY-0626-0500.

Connecting cables for Jetter motors with brake:

The motor cables (for motors with brake) of the designation KAY-0624-xxxx can be ordered in the following standard lengths in meters:

1	1.2	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5
7	7.5	8	9	10	11	12	13	14	15	16	17	18
20	22	24	25	30	50							

The order number xxxx designates the length in cm.
Example: A motor cable of 5 meters length has got the designation KAY-0624-0500.

11.4 Resolver Cable

The resolver cable of the designation KAY-0623-xxxx can be ordered in the following standard lengths in meters:

1	1.2	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5
7	7.5	8	9	10	11	12	13	14	15	16	17	18
20	22	24	25	30	50							

The order number xxxx designates the length in cm.
Example: A motor cable of 5 meters length has got the designation KAY-0623-0500.

11.5 System Bus Cables

Connection cables for the Jetter system bus:

Length 0.2 m	CABLE CONF NO. 0530 0.2m	Art. no. 10309001
Length 0.5 m	CABLE CONF NO. 0530 0.5m	Art. no. 10309002
Length 1.0 m	CABLE CONF NO. 0530 1.0m	Art. no. 10309003
Length 1.5 m	CABLE CONF NO. 0530 1.5m	Art. no. 10309004
Length 2.0 m	CABLE CONF NO. 0530 2.0m	Art. no. 10309006
Length 2.5 m	CABLE CONF NO. 0530 2.5m	Art. no. 10309016
Length 3.0 m	CABLE CONF NO. 0530 3.0m	Art. no. 10309015
Length 4.0 m	CABLE CONF NO. 0530 4.0m	Art. no. 10309007
Length 5.0 m	CABLE CONF NO. 0530 5.0 m	Art. no. 10309008

Other lengths can be obtained on request.

Appendices

Appendix A: Recent Revisions

Recent Revisions Made in Edition 2.10.1:

Chapter	Comment	Revised	Added	Deleted
Introduction	System requirements		✓	
5.1	Motor peak current = 10 A	✓		
7.1	Wire calculation	✓		
7.2	Voltage supply	✓		
7.3	The servo motor	✓		
7.4	Brush-equipped DC motor		✓	
7.5	2-phase stepper motor		✓	

Appendix B: Glossary

AC	**A**lternating **C**urrent Alternating Current
CE	**C**ommunautés **E**uropéennes European Union
DC	**D**irect **C**urrent Direct current
DIN	**D**eutsches **I**nstitut für **N**ormung e.V. = German Industry Standard
DSP	**D**igital **S**ignal**P**rocessor
EU	**E**uropean **U**nion
EC Low Voltage Directive	To be considered when using electric devices of a rated voltage between 50 and 1,000 V AC and between 75 and 1,500 V DC.
Electro-Magnetic Compatibility (EMC)	Definition according to the EMC regulations: "EMC is the ability of a device to function in a satisfactory way in an electro-magnetic environment without causing electromagnetic disturbances itself, which would be unbearable for other devices in this environment."
EN	**E**uropäische **N**orm, that is: European Standard
ESD	**E**lectro **S**tatic **D**ischarge
Hazard Analysis	Extract from the Machinery Directive 98/37/EC: "The manufacturer is under an obligation to assess the hazards in order to identify all of those which apply to his machine; he must then design and construct it taking account of his assessment."
Hardware Enable	Hardware or software enable has to be applied, before the axis can be activated by software enable. This means that to the enable input or at several enable inputs, a high signal (24 V) has to be connected (restart inhibit).
HIPERFACE	**Hi**gh **Per**formance Inter**face** HIPERFACE designates a sensor-transducer system by Sick / Stegmann. The SinCos motor feedback system with the standardised HIPERFACE interface is often used in digital drive technology. Unlike the resolver, the SinCos motor feedback system with HIPERFACE interface contains electronic components. Over several motor rotations, a HIPERFACE will report the absolute position values; this cannot be performed by a resolver. A HIPERFACE is far more precise than a resolver, but also more expensive.
IEC	**I**nternational **E**lectrotechnical **C**ommission
IGBT	**I**nsulated **G**ate **B**ipolar **T**ransistor
IP	**I**nternational **P**rotection

JetMove	JetMove is the product designation of a digital servo amplifier series produced by Jetter AG, e.g. JetMove 105 with – D - it stands for "Dual", in the sense of controlling two motors – 203 - it identifies a rated current of 3 A
Jetter System Bus	The Jetter system bus is a system bus system of a cable length of 200 m max. , and of fast data transmission rates of 1 Mbit/s. In addition to this, the Jetter system bus is highly immune to interferences. Therefore, the Jetter system bus is suited to realise field bus applications in a limited space.
JetWeb	Control technology comprising control systems, motion systems, user interfaces, visualization devices, remote I/Os and industrial PCs. Programming by means of multitasking and a modern sequence-oriented language. Communication by means of Ethernet TCP/IP and making use of the Web technologies.
Motor circuit-breaker	A circuit-breaker with monitoring functions of phases and temperature of a motor.
NN	**N**ormal **N**ull = Sea Level
PE	**P**rotective **E**arth , respectively "Protective Earth Conductor"
Resolver	Feedback unit at a servo motor for determining the absolute position within one revolution. Other than a HIPERFACE, the resolver will not provide any information on how many revolutions the motor has performed so far. A resolver could be envisaged as a transformer; the couplings of its secondary windings (sine and cosine) change in relation to the position of the motor shaft. Basically, a resolver consists of a rotor with one coil and a stator with two coils. The stator windings are displaced by 90° (sine and cosine). The resolver itself does not contain any electronic components.
SELV	Safe Extra Low Voltage: Voltage, which, under all operating conditions will not exceed a peak or DC voltage of 42.4 V. This voltage is either measured between two conductors or between one conductor and earth. The circuit, in which this voltage occurs, must be separated from the mains power supply by a safety isolating transformer or some equivalent.
Software Enable	A higher-level controller enables an axis by means of a software instruction. This way, the motor is energized. Hardware enable has to precede software enable (restart inhibit).
SUB-D	Type name of a plug-in connector
t_r/t_h	**t**ime **r**ise / **t**ime **h**old: "rise time of a pulse / total hold time of a pulse"

t_r/t_n	**t**ime **r**ise/**t**ime **n**ormal:"rise time of a pulse/total duration of a pulse" "rise time of a pulse / total duration of a pulse"
TN network	Supply network which is solidly earthed in the neutral point and which is equipped with a protective earth conductor.
TT network	Supply network which is solidly earthed in the neutral point, yet, which is not equipped with a protective earth conductor. Earthing is carried out by means of a local protective earth.
UL	**U**nderwriters **L**aboratories Inc.
VDE	**V**erband **d**eutscher **E**lektrotechniker e.V. = Association of German Electrical Engineers
DC link voltage	DC circuit within a servo drive on the basis of which the motor currents are generated.
ϑ_{NAT}	Transition temperature, at which the thermal sensor changes by several K within a range of +/- 5 K.Ω .

Units:

A	Ampere
mA	Milliampere (1 mA = 10^{-3} A)
dB	Dezibel
g	gram
h	Hour
Hz	Hertz
K	Kelvin
m	Meter
cm	Centimeter (1 cm = 10^{-2} m)
mm	Millimeter (1 mm = 10^{-3} m)
s	Second
V	Volt
µV	Microvolt (1 µV = 10^{-6} V)
W	Watt
Ω	Ohm
°C	Degrees centigrade (temperature unit)
°	Degrees (angular dimension)
Ws, J	Watt seconds, Joule

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